NUCLEAR SCIENCE ABSTRACTS

Volume 26 Number 7

Abstracts 14655-17330

April 15, 1972

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Each author's name is indexed in the form appearing on the document abstracted:

NEWCOMB, William A., Stability of a magnetic well, 25:1239
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NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/81b-254)

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution, 25:251(P)

TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

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Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

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CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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30(Pt.2)	25-331	Dep. NTIS
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 14801, 15390, 15632, and 16567.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 14867, 15039, 15052, 15204, 15269, 15755, 16767, and 17109.

14655 (ANCR-1016, pp 357-77) RESEARCH AND DEVELOPMENT FOR NONREACTOR RELATED DISCIPLINES. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

Neutron activation analysis was used to determine the Hg content of game birds (mostly pheasant) sampled in Idaho during 1970. One thousand samples, encapsulated in quartz, were irradiated in the core region of the Materials Testing Reactor. The neutron intensity varied from approximately $2.5 \times 4 \times 10^{13}$ n/cm^2 sec. The reactor was operated for 48 hours. No results are reported. Samples of human blood and blood serum were analyzed for typical trace elements (Cl, Na, K, Br, Fe, Cu, Se, Hg, Au, and Zn) by neutron activation methods. The elements were activated by thermal neutrons, samples were γ counted using a 35-cc Ge(Li) detector with a 4096 channel analyzer and magnetic tape readout. Analysis of the data was done by means of an automated spectrum analysis program known as GAUSS. No data are included. (C.H.)

14656 (CONF-680423-, pp 31-42) ANALYSIS OF ROCKS AND METEORITES BY MEANS OF NEUTRON ACTIVATION. Haskin, Larry A. (Wisconsin Univ., Madison. Dept. of Chemistry). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The neutron activation methods used for the determination of rare earths, Na, Mn, and Sc in meteorites and rocks are reported. Some of the results obtained are discussed. (J.S.R.)

14657 (CONF-680423-, pp 54-60) SOME COMMENTS ON ACTIVATION ANALYSIS. Meinke, W. Wayne (National Bureau of Standards, Washington, D. C.).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

An overview of activation analysis as it stands in relation to other methods of analysis is presented. Activation analysis is not a survey method such as emission spectrography or spark-source mass spectrography; however, it is inherently an accurate method. Thus activation plays a very important role in the preparation and development of accurate values for certified materials that are so essential for meaningful measurement with survey methods. It was concluded that activation analysis should be considered only as one of a number of trace analytical techniques that complement each other in the attack on practical trace problems. (D.H.M.)

14658 (CONF-680423-, pp 61-4) ANALYSIS BY INSTRUMENTAL ACTIVATION IN MATERIALS OF HIGH PURITY. Ortega, Ruben F. (Comision Nacional de Energia Nuclear, Mexico City). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

Instrumental activation analysis is a high-sensitivity technique in the detection of traces and which gives additional information on the purity of crystals. The method can be semiautomated. The method is described and the results obtained are reported. Concentrations of 50 to 100 ppM in rare earths and other elements could be detected in crystals by this method. The method of least squares is used for the resolution of the γ spectra induced by the radiation. (J.S.R.)

14659 (COO-912-24) NEUTRON ACTIVATION ANALYSIS OF STREAKS FROM COINS AND METALLIC WORKS OF ART. Gordus, Adon A. (Michigan Univ., Ann Arbor. Dept. of Chemistry). [1970]. 28p. (CONF-700663-1). Dep. NTIS.

From Symposium on the application of scientific methods in the analysis of works of art; Boston, Mass. (June 1970).

Two nondestructive methods of activation analysis of coins and art objects are described. The first method consists of irradiating a coin for one minute in a low-intensity neutron source followed by a one-minute analysis of the induced silver radioactivity. Using this method, the silver fineness of a coin can be determined to ±1 to 1.5%. The second method consists of removing the corrosion layer on a tiny area of the coin or art object by stroking the edge with fine-grained emery paper. A small, clean piece of roughened quartz tubing is then rubbed on the brightened area of the coin edge producing a streak on the tubing. Usually 40 to 50 streaks from coins plus 5 streaks from alloys of known composition are irradiated for two hours at a neutron intensity of 3×10^{13} neutrons $\cdot$ cm$^{-2} \cdot$ sec^{-1}. The irradiated streaks are then mounted separately on cards and analyzed for their silver, gold, copper, zinc, arsenic, and antimony radioactivity. (D.H.M.)

14660 (IAEA-R-574-F) ASSAYS FOR SELENIUM AND CHROMIUM IN BLOOD AND FOODSTUFFS BY NEUTRON ACTIVATION ANALYSIS. Final Report for the Period 1 November 1967-31 October 1970. Maxia, V. (International Atomic Energy Agency, Vienna (Austria)). Apr 1971. 12p. INIS.

Selenium and chromium concentrations in human blood, foodstuffs, and institutional diets from the United Arab Republic and, to a lesser extent, from Italy, were determined by neutron activation analysis. The possible role of these elements in protein-calorie malnutrition was examined by analysis of blood samples from children hospitalized with kwashiorkor as well as from controls. Blood selenium levels were determined by instrumental analysis based on the activation product ^{77m}Se; other analyses were carried out by the use of the activation products ^{75}Se and ^{51}Cr. Fruits and vegetables (with a few notable exceptions) and milk were generally found to be poor sources of selenium; cereals, beans and meats were comparatively rich sources (approx. 0.1 μg/g dry weight). Green leafy vegetables were the most important sources of dietary chromium. Institutional diets provided 29 μg selenium and 124 μg chromium (median values) per day. Blood selenium levels in kwashiorkor children admitted to hospital did not differ significantly from those in healthy children and showed only minor changes during the course of clinical recovery. Blood chromium levels in kwashiorkor children, likewise, showed little or no difference from values for healthy children. In the United Arab Republic, therefore, dietary selenium and chromium do not appear to play an important role in protein-calorie malnutrition. (INIS)

14661 (IJS-R-596) EXTRACTION OF SOME ELEMENTS AS IODIDES FROM SULPHURIC ACID-POTASSIUM IODIDE MEDIA WITH TOLUENE, AND ITS APPLICATION TO NEUTRON ACTIVATION ANALYSIS. PART I. EXTRACTION BEHAVIOUR OF As, Br, Cd, Cu, Ga, Ge, In, Hg, Mo, Sb, Se, Sn, W, AND Z. Byrne,

A, R. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1971. 17p. Dep. NTIS (U. S. Sales Only).

As the first stage in the development of separation methods for neutron activation analysis by solvent extraction of iodides with toluene from sulfuric acid–potassium iodide media, quantitative data on 14 elements were obtained. Extraction curves at four or more potassium iodide molarities are presented as a function of acidity for the five extractable elements As, Ge, Hg, Sb, and Sn. Information in tabular form is given for the elements Br, Cd, Cu, Ga, In, Mo, Se, W, and Zn over a range of conditions. The extraction curves are characteristic and enable a number of clean and useful separations to be made. (auth)

14662 (IRI–133–71–17) DETERMINATION OF MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT. De Goeij, J. J. M. (Interuniversitair Reactor Instituut, Delft (Netherlands)). [1971]. 21p. (CONF-710818–4). Dep. NTIS (U. S. Sales Only).

From Meeting on nuclear methods in environmental research; Columbia, Mo. (23 Aug 1971).

Studies were made on chemical separation methods for use in determination of mercury by neutron activation. Samples are irradiated in quartz vials. The vials are cleaned externally, dipped into liquid nitrogen, and broken for placement in a distillation vessel. The sample is decomposed with H_2SO_4, oxidized with H_2O_2, and the mercury volatilized. An inactive mercury droplet is mixed with the solution used to trap the volatilized material, collected on a filter, dissolved in HNO_3, and counted. An automated instrument was developed. The method has a sensitivity of 10^{-9} to 10^{-10} g or 1 to 0.1 ppB using a 1 g sample with a standard deviation of 3 to 4% in the ppM range and 10 to 15% in the ppB range. (M.C.G.)

14663 (ORNL–tr–2556) NEUTRON ACTIVATION ANALYSIS OF ORES FOR FLUORITE ON A CONVEYOR. Ivanov, I. N.; Markun, N. Yu.; Shtan, A. S. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Radiats. Tekh.; No. 6, 131–4 (1971). 4p. Dep. NTIS.

Neutron activation methods for continuous determination of the fluorite content of ores are described. The fluorite content is determined from ^{16}N, formed in the $^{19}F(n,\alpha)^{16}N$ reaction, and comparing results with results of analysis of known standards. (M.C.G.)

14664 AUTOMATED NUCLEAR ACTIVATION ANALYSIS IN GEOCHEMISTRY. Fite, L. E.; Wainerdi, R. E. Miner. Sci. Eng.; 2: No. 3, 3–16(1970).

Nuclear activation provides a sensitive, nondestructive method for analysis of minor, trace, and ultratrace elements. Automation of the technique and use of computers for data interpretation permit routine analysis of greater numbers of samples. With development of lithium-drifted germanium detectors, applications have become more practical. The theory of neutron activation analysis is briefly outlined, and procedures for employing the technique are discussed. The automated activation analysis systems, developed for use with large numbers of similar samples, and small systems, developed for in situ geochemical analysis, are described; and limitations of both are discussed. Analysis by inelastic scattering, capture gamma-ray, cyclic activation, and decay activation is described. A few applications of nuclear activation analysis to geochemical problems are presented. (Abstr. N. Amer. Geol.)

14665 USE OF RESONANCE NEUTRONS IN ELEMENTARY ANALYSIS. Gambaryan, R. G.; Shtan, A. S. Tr. Vses. Nauch.-Issled. Inst. Radiats. Tekh.; No. 4, 161–75(1970). (In Russian).

To minimize the effects of interfering nuclear reactions in neutron activation and neutron absorption analysis, use is made of a shield prepared from the element being determined. The sample is irradiated twice, once with, and once without, screening by this shield; in both instances the sample is also shielded by cadmium to exclude thermal neutrons. The difference between the activities induced in the two irradiations is a measure of the absorption of resonance neutrons of a specific energy group (and also of the content of the element being determined). The method has been used in the determination of Rh, Ag, In, and Ir by a neutron absorption technique, and in activation analysis for Au, Ir, and In. (Referativnyi Zh.)

14666 TRACES OF COPPER DETERMINED IN LUMINESCENT ZINC SULFIDE BY NEUTRON ACTIVATION ANALYSIS. Hegedues, Dezso; Noszticiusz, Zoltan; Erdey, Laszlo. Magy. Kem. Lapja; 26: No. 7, 344–7(Jul 1971). (In Hungarian).

On the basis of the determinations and model tests carried out, preliminary separation methods with precipitation exchange, extraction, and ion exchange can be stated to be similarly suitable for the determination of the copper content of zinc sulfides with lower copper concentration. The preliminary separation with paper chromatography is suitable mainly for analyzing small quantities of samples with higher copper content. (auth)

14667 PHOTOACTIVATION ANALYSIS. Slunecko, Jaroslav; Kosta, Lado (Jozef Stefan Inst., Ljubljana, Yugoslavia). Chem. Listy; 65: No. 10, 1009–38(Oct 1971). (In Czech).

Essential information is presented regarding the application of activation by gamma rays to analysis. Basic data on sources of photons, techniques of irradiation, character of curves representing effective cross sections, counting techniques, relations between different reactions, and possible interferences are presented. An important part of the paper is a table of isotopes selected on the basis of their suitability for determining elements by gamma activation analysis. The table contains 236 isotopes with respective reactions, threshold values for their formation, half-lives, energies of their characteristic radiations, and sensitivities. (auth)

14668 RADIOACTIVATION ANALYSIS OF SELENIUM WITH 14 MeV NEUTRONS. Tsuji, Haruo; Kusaka, Yuzuru (Konan Univ., Kobe, Japan). Jap. Anal.; 20: No. 10, 1265–70(Oct 1971). (In Japanese).

Nondestructive activation analysis of selenium in slime obtained during electrolytic refining of copper was studied by means of $^{78}Se(n,2n)^{77m}Se$ and $^{77}Se(n,n')^{77m}Se$ ($T_{1/2}$ = 17.5 sec, E_γ = 0.162 MeV) reactions with 14-MeV neutrons. The irradiation samples were prepared by mixing the slime with graphite powder (1 : 2). The neutron flux monitor which makes it possible to normalize all the counting results to those which are obtained under specific irradiation conditions (the neutron flux = 1.5×10^7 n/cm^2 · sec) was a mixture of elementary selenium (40%) and graphite powder. Several standard samples, each containing a definite amount of selenium (0 to 10%), were prepared by the same manner as the monitor. Five-gram amounts of these samples were packed tightly in polyethylene rabbit capsules (35 mm long, 13 mm i.d., 1 mm thick). A sample and a monitor capsule were connected by a 60-mm-long steel spring, and the combined samples were irradiated and counted simultaneously. The geometrical situations of the combined samples during counting and irradiation are illustrated. The analytical procedures consisted of a 1-min activation, a 10-sec delay, and a 30-sec counting. The gamma spectra of selenium and copper standard samples are given. The 0.162-MeV photopeak of ^{77m}Se was interfered with by Compton scattering and backscattering peaks of annihilation radiation from $^{63}Cu(n,2n)^{62}Cu$ reaction. In order to eliminate these interferences, gamma spectrometry based on a $\gamma-\gamma$ sum anticoincidence counting method was used. Two 2″ × 2″ NaI(Tl) detectors were used. The gamma spectra and the photopeak intensities obtained by this counting method are compared with data by the usual counting method. Thus, short-lived ^{77m}Se could be measured in the presence of an appreciable amount of copper. The specific activity obtained with the standard sample was 2516 counts/30 sec/100 mg Se with relative error of 2 to 3% when the determination was repeated for 5 or 6 times. When the neutron flux was 1.5×10^7 n/cm^2 · sec, the limit of the detection of selenium was 10 mg, that is, the detection is possible if the selenium content in a 5-g sample is above 0.2%. Result of the determination of selenium in various slime samples is given. Thus, it is shown that the method is effective for 14-MeV neutron activation analysis using short-lived nuclides. (auth)

14669 PNEUMATIC TRANSFER SYSTEM IN NEUTRON ACTIVATION ANALYSIS OF OXYGEN. Miyoshi, Katsuhiko; Fujii, Isao (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Jap. Anal.; 20: No. 10, 1323–6(Oct 1971). (In Japanese).

The 14-MeV neutron activation analysis has been used for the rapid and nondestructive determination of oxygen in steel. A reliable and fast sample transfer system is necessary for this application because of the short half-life of ^{16}N. Essential provisions are discussed. The pneumatic transfer system is most suitable, and the transfer speed of sample from the bombardment position to the measuring place is required to be less than 3 sec. In order to secure fully automatic operation of the system, reverse-mounted, tandem blowers are used. This makes it possible to control the sample transfer by electrical means. (auth)

14670 ACTIVATION ANALYSIS OF OXYGEN WITH FAST NEUTRON IN ARSENIC TRICHLORIDE. Ishikawa, Hiroshi; Ishii, Eiichi; Nakane, Masanori; Miyake, Yoshizo (Government Industrial Research Inst., Osaka). Jap. Anal.; 20: No. 11, 1370–4(Nov 1971). (In Japanese).

Activation analysis of traces of oxygen in arsenic trichloride was carried out using the $^{16}O(n,p)^{16}N$($T_{1/2}$ = 7.4 sec, mainly 6.13; 7.13-MeV γ ray, 10.4-MeV β ray) reaction with 14-MeV neutrons. Nine grams of the sample were sealed in the polyethylene container for irradiation. The irradiation time was controlled automatically and the activity of ^{16}N was measured with a 1¾ in. ×

2 in. well-type NaI(Tl) scintillation detector and 800 channel pulse height analyzer. When the matrix is different between samples, it is necessary to correct for the effects of self-shielding against 14-MeV neutrons and self-absorption against radiations ($\gamma + \beta$ ray) from ^{16}N. The precision expressed in terms of the coefficient of variation was 6 to 12% at the range of 1 to 60 mg oxygen, and the determination limit was 60 ppM. This method was applied to evaluate the total oxygen content in arsenic trichloride in equilibrium with water and hydrochloric acid and also in arsenic trichloride dehydrated by various procedures after equilibration with water. The results were compared with water contents in arsenic trichloride obtained by the radiotracer method using tritium as tracer. Arsenic trichloride contained large amounts of oxygen in forms other than water. Most of oxygen contained as H_2O could be removed by dehydration with anhydrous magnesium sulfate. The other oxygen, probably existing as AsO^+, could be removed by distillation. (auth)

14671 DETERMINATION OF TELLURIUM BY INSTRUMENTAL PHOTON ACTIVATION ANALYSIS. Campbell, F. T.; Steele, E. L. (Louisiana State Univ., Baton Rouge). Anal. Lett.; 4: No. 7, 445-50(Jul 1971).

Tellurium was determined at milligram and submilligram levels in the presence of uranium by a strictly instrumental photon activation analysis procedure. The 575-keV gamma ray of ^{121}Te was measured. At a decay time of three weeks, this gamma ray peak was interference-free. As little as 0.4 mg of tellurium was determined. Results indicate that sensitivity would increase with irradiation time. (auth)

14672 DETERMINATION BY NEUTRON ACTIVATION ANALYSIS OF SELECTED ELEMENTS IN CIGARETTES. Jenkins, Robert W. Jr. (Philip Morris Research Center, Richmond, Va.); Newman, Richard H.; Ikeda, Robert M.; Carpenter, Robert D.; Williamson, Thomas G. Anal. Lett.; 4: No. 7, 451-7(Jul 1971).

Neutron activation analysis was used for the determination of Na, Al, Cl, K, Ca, Sc, Mn, Cu, Br, and La in the tobacco, mainstream smoke condensate, paper, and dropped ash of the Kentucky Reference Cigarette (IRI). The procedure requires no sample transfers prior to activation and no radiochemical separations before counting. (auth)

14673 NONDESTRUCTIVE DETERMINATION OF MERCURY IN COPPER BY THERMAL NEUTRON ACTIVATION ANALYSIS. Gillette, Robert K. (Monsanto Research Corp., Miamisburg, Ohio). Anal. Lett.; 4: No. 9, 563-72(Sep 1971).

Thermal neutron activation analysis was applied to the nondestructive determination of parts per billion quantities of mercury in high purity, oxygen-free high conductivity (OFHC) copper. The data were treated to a five-point gamma spectrum smoothing to reduce the statistical variations due to the low count rates. Linear regression and a statistical evaluation of the data were also performed. Net photopeak counting rates of approximately 43 counts per minute (cpm), compared to a background of approximately 6 cpm, were obtained for six two-gram copper samples containing 38 ± 12 ppB mercury. (auth)

14674 CYANIDE EXTRACTION AND ELECTRODISPOSITION OF TRACE AMOUNTS OF RADIOACTIVE SILVER FROM LARGE BIOLOGICAL SAMPLES. Hodge, V. F.; Folsom, T. R. (Univ. of California, San Diego, La Jolla). Anal. Chem.; 44: No. 2, 381-3(Feb 1972).

A method is described for the determination of trace amounts of ^{108m}Ag and ^{110m}Ag in kilogram quantities of wet tissue without interferences from ^{60}Co and ^{65}Zn. Very small amounts of fallout silver were recovered from fresh liver tissue by stirring the comminuted liver into basic cyanide solution, and allowing about two days for the added silver to exchange with the radioisotopes. The silver is then plated directly from the slurry onto platinum strips. The silver is stripped from the platinum with nitric acid and collected as its chloride precipitate. Samples were counted using a NaI γ spectrometer. (J.G.B.)

14675 ELECTRODEPOSITION OF ACTINIDES FOR ALPHA SPECTROMETRIC DETERMINATION. Talvitie, N. A. (Western Environmental Research Lab., Las. Vegas, Nev.). Anal. Chem.; 44: No. 2, 280-3(Feb 1972).

A procedure for the electrodeposition of Pu, Th, U, and Am as hydrous oxides is given. Deposition recoveries from 1M ammonium sulfate at pH 2 ranged from 98.8 to 99.8% in 120 minutes of electrolysis at 1.2 A. A 40-minute electrolysis period was adequate for the alpha spectrometric determination of plutonium using ^{236}Pu as an internal tracer standard. In the absence of an internal standard, the electrodeposition efficiency can be determined by repeating the electrodeposition. The complexing property of the sulfate ion prevents premature hydrolysis and precipitation of actinides and iron. Oxalic acid can be used for additional suppression of iron interference but it inhibits the deposition of actinides. Cross contamination in low-level analyses of environmental and biological samples is avoided by use of low-cost disposable polyethylene cells and electropolished stainless steel planchets. (auth)

14676 INVESTIGATION OF TRACE ELEMENTS IN PETROLEUM USING NEUTRON ACTIVATION ANALYSIS. Filby, Royston Herbert. Pullman, Wash.; Washington State Univ. (1971). 137p. University Microfilms Order No. 71-28,765.

Thesis.

Neutron activation analysis was used to measure the following elements in crude oil and crude oil components (detection limits for a 1-g sample in ng/g in parentheses): Ni (30), V (2), Co (0.02), Hg (4), Fe (400), Zn (90), Cr (23), Cu (100), Mn (30), As (6), Au (10^{-3}), Sb (1), Se (23), Sc (0.1), Na (20), and Ca (4,000). The method suffers from only minor fast-neutron interfering reactions, the most significant being $^{60}Ni(n,p)^{60}Co$. The method is nondestructive and eliminates contamination from reagents and apparatus. Sample sizes as small as 50 mg could be measured. Conventional dry ashing leads to serious losses of volatile compounds of Ni, Hg, Sb, As, Se, V, and Cu. The H_2SO_4-ashing procedure leads to serious losses of Hg, Sb, As, Se, and Cu. For Hg more than 95% of the Hg present in a crude oil containing 21.2 μg/g Hg was lost in both ashing methods. Analyses of 10 oils showed large variations in trace element contents. The ranges of values observed for each element were: Ni (1.3 to 117 μg/g), V (4.0 to 168 μg/g), Co (0.001 to 14.5 μg/g), Hg (0.014 to 21.2 μg/g), Fe (3.74 to 89.5 μg/g), Zn (0.091 to 19.6 μg/g), Cr (0.042 to 0.729 μg/g), Mn (0.21 to 3.10 μg/g), As (0.046 to 1.63 μg/g), Au ($<10^{-1}$ to 6.4×10^{-5} μg/g), Sb ($<10^{-3}$ to 0.273 μg/g), Se (0.009 to 0.678 μg/g), Sc ($<10^{-5}$ to 0.009 μg/g), Cu (0.13 to 6.33 μg/g), Na (<1.0 to 65.2 μg/g), and Ca(<20 to 192 μg/g). All elements were shown to occur in oil-soluble form but Na, As, and Sb were shown to occur partly as water-soluble compounds. All elements were more concentrated in the asphaltenes than in the maltenes of three crude oils. The ratios of asphaltene/maltene concentrations varied from 3.57 (Se) to 92.8 (Sb). (Diss Abstr. Int., B)

14677 ELECTRODEPOSITION OF ALPHA-EMITTING NUCLIDES FROM A MIXED OXALATE–CHLORIDE ELECTROLYTE. Puphal, Kenneth W.; Olsen, Donald R. (Health Services Lab., Idaho Falls, Idaho). Anal. Chem.; 44: No. 2, 284-9(Feb 1972).

A method is described for electrodepositing various alpha-emitting nuclides, singly or in combination, onto a stainless steel cathode. The nuclides are deposited as hydroxides to better than 98% in 50 minutes from an ammonium chloride–ammonium oxalate electrolyte. The optimum conditions were determined by studying the effects of time, current, electrolyte concentration, electrode spacing, pH, and the effect of hydroxylamine as a reducing agent. Additional studies include electrolyte variations with strong organic acids and a diverse ion study of various anions and cations. The use of a chelating agent reduced the interference of some cations and greatly improved the yield and precision of several nuclides. Fluoride markedly alleviated the interference caused by iron, aluminum, natural thorium, and zirconium. However, the presence of even microgram quantities of the rare earths caused serious losses in the presence of fluoride. The procedure was developed with ^{239}Pu but is applicable to thorium, protactinium, uranium, neptunium, americium, curium, and californium, as well as cerium, polonium, and bismuth. Five replicate depositions of ^{239}Pu gave an error of less than 2% standard deviation at the 95% confidence level with an average yield greater than 99%. The resolution obtained with ^{241}Am was 24 keV full width at half maximum peak height. (auth)

14678 X-RAY SPECTROGRAPHY OF ELEMENTS FROM SODIUM TO CALCIUM (ATOMIC NUMBERS 11 TO 20). Vander, I. Z.; Ioffe, E. M. Byull. Nauch.-Tekh. Inform. Agron. Fiz.; No. 14, 33-41(1970). (In Russian).

The relative effectiveness of tritiated titanium, tritiated zirconium, ^{55}Fe, and ^{238}Pu as excitation sources for this purpose is assessed, and an equation is proposed for calculating the intensity of the characteristic radiation from a sample. Agreement between experimental and calculated values is excellent. A source of ^{238}Pu or tritiated zirconium is recommended for determining the elements from Na to P, and one of ^{55}Fe or tritiated titanium for the elements from S to Ca. (Referativnyi Zh.)

14679 SIMULTANEOUS DETERMINATION OF GOLD, MERCURY, SILVER, TELLURIUM AND URANIUM BY INSTRUMENTAL NEUTRON AND PHOTON ACTIVATION ANALYSIS. Campbell II, Frank Thomas. Baton Rouge, La.; Louisiana State Univ. (1971). 124p. University Microfilms Order No. 71-29,349.

Thesis.

A rapid, inexpensive method for the determination of gold, mercury, silver, tellurium, and uranium was developed. The method utilized nondestructive activation analysis by means of γ spec-

trometry. Both neutrons and photons were used as sources of activation. Irradiation of a stable nucleus with neutrons results in the formation of an unstable nucleus of mass number one greater than the target nucleus while bombardment with photons causes a loss of one mass number. The different radioisotopes yield different γ spectra thus enhancing the likelihood of obtaining an interference-free peak. Computer reduction of the data reduces the time required for analysis to two hours per sample, only slightly more than the counting time. Minimal laboratory skill is required to obtain sensitivities as follows: Au–3.4 ppM; Hg–74.6 ppM; Ag–198.1 ppM; Te–120.0 ppM; and U–16.6 ppM. (Diss. Abstr. Int., B)

14680 SIMPLE CALIBRATION METHOD OF DISCRIMINATOR LEVEL IN THE HIGH ENERGY γ-RAY MEASUREMENTS BY USING ^{24}Na. Miyoshi, Katsuhiko; Fujii, Isao (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Jap. Anal.; 20: No. 10, 1326-8(Oct 1971). (In Japanese).

When oxygen is determined by a 14-MeV neutron activation method, the high energy γ rays from ^{16}N in the range 6 to 7 MeV are measured. In order to count only those from ^{16}N, it is necessary to discriminate the γ-ray portion below a certain energy level. As no γ-ray reference sources having a γ-ray spectrum in the range 3 to 6 MeV are commercially available, the determination of the discriminator level was studied by the use of ^{24}Na that can be obtained by a bombardment of Al samples with neutrons. ^{24}Na has a high energy γ spectrum in the range 1.24 to 4.22 MeV for a well-type NaI(Tl) crystal. This method exhibits simplicity and remarkable reproducibility. The Al sample can be used repeatedly; it is not necessary to provide a new Al sample before the experiment. Furthermore, the use of a multi-channel pulse height analyser can be avoided. It was also found that the response of a NaI(Tl) crystal for γ rays is quite linear until a high energy level. (auth)

14681 DETERMINATION BY NEUTRON ACTIVATION OF SOME LANTHANIDES IN BARITE. Guichard, F. (Laboratoire de Geologie Applique, Paris); Jaffrezic, H.; Deschamps, N.; Treuil, M. Radiochem. Radioanal. Lett.; 9: No. 1, 35-43(15 Jan 1972). (In French).

A radioanalytical method is proposed for the determination of rare earth metals in barite samples. Irradiated samples were dissolved in a HCl solution immediately after fusion with alkali. The rare earth ions were retained on calcium fluoride. A high resolution lithium-drifted germanium detector was used to determine the concentrations. Preliminary results are reported. (auth)

14682 N-BENZOYL-N-PHENYLHYDROXYLAMINE AS A SUBSTOICHIOMETRIC EXTRACTANT IN ACTIVATION ANALYSIS. II. DETERMINATION OF COPPER. Tejam, B. M.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 9: No. 1, 19-26(15 Jan 1972).

A rapid method was developed for the determination of trace amounts of copper by neutron activation and substoichiometric extraction with N-benzoyl-N-phenylhydroxylamine in chloroform. The method was used for the determination of copper in steel and biological standard materials. (auth)

14683 ANALYTICAL POSSIBILITIES OF A BETATRON WITH INTRACHAMBER IRRADIATION. II. THE ELEMENTS Rb–U. Kuznetsov, R. A. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 498-500(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 473-5(May-Jun 1971).

Samples were irradiated in the accelerator chamber of the betatron at bremsstrahlung energies of 15.6, 18.6, 23, and 26.3 MeV. The data obtained on the specific activities of elements from Rh to U are given. (M.C.G.)

14684 ANALYTICAL POSSIBILITIES OF A BETATRON WITH INTRACHAMBER IRRADIATION. III. SENSITIVITY AN AND SELECTIVITY. Kuznetsov, R. A. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 501-4(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 475-8(May-Jun 1971).

The distribution of elements according to sensitivity of determination is discussed. It is shown that the highest electricity is possessed by photoactivation analysis with respect to radioisotopes with hard γ radiation. The most promising regions of application of instrumental photoactivation analysis are considered. (M.C.G.)

14685 NON-DESTRUCTIVE NEUTRON ACTIVATION DETERMINATION OF URANIUM BY THE 106 keV-γ-PEAK OF ^{239}Np. I. THE EFFECT OF Th, Ta, Pt, Ru, Zn, AND Ba. Kuleff, I.; Todorovsky, D. (Univ., Sofia). Z. Anal. Chem.; 257: No. 1, 23-8 (1971).

In order to clarify the possibilities of the nondestructive neutron activation analysis of μg quantities of uranium by the 106-keV γ peak of neptunium-239 with a NaI(Tl) detector, the effects of Th, Ta, Pt, Ru, Zn, and Ba on the determination were investigated. These elements when irradiated in a nuclear reactor with epithermal neutrons yield radioactive isotopes the γ radiation of which interferes with the U determination. The following values of the ratio of the concentration of the element to that of uranium in the samples are established at which the error induced by the elements is within the limits of the experimental precision (~5%): Th 3.0; Ta 2.5; Pt 45; Ru 10; Zn 500 (30 min irradiation and time of cooling 72 h). On the basis of these data the objects to which the application of the nondestructive method is affected are indicated, as well as the possibilities of estimating the interfering effect when the element quantities exceed the established values. (auth)

14686 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF SUBMILLIGRAM SAMPLES OF LUNAR SOIL. Vobecky, M. (Nuclear Research Inst., Rez, Czech.); Frana, J.; Randa, Z.; Benada, J.; Kuncir, J. Radiochem. Radioanal. Lett.; 9: No. 1, 55-62(15 Jan 1972).

Instrumental neutron activation was applied to the analysis of submilligram amounts of mineral and vitreous fractions separated from lunar soil samples. Thirty-two elements were determined, including rare earths, Th, U, Sc, and Zr. (J.G.B.)

14687 SAMPLING AND SAMPLE HANDLING OF HUMAN TISSUE FOR ACTIVATION ANALYSIS. Maletskos, Constantine J.; Albertson, Mark D.; Fitzsimmons, Jane C.; Masurekar, Malthi R.; Tang, Chung-wai (New England Deaconess Hospital, Boston). pp 367-77 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

Sampling is conducted by pathologists, the only requirements being that the tissues not be pierced by any tools and that they be frozen as soon as possible in reasonably clean containers. The preserved frozen tissues are aliquoted in the frozen state, two sampling methods having been developed for comparison purposes. In one method, a frozen sample is shaped to the size desired and then shaved with a boron nitride tool of high purity, the constituents of which (B and N) do not interfere with the activation analysis. In the second method, the sample is shaped to size and the outer surfaces identified with green dye. The sample is then shattered and a piece from the interior with no dye is removed for analysis. To minimize contamination, sample handling is conducted in a glove box with a variety of special tools and facilities, and the samples are freeze-dried in clean vials in special isolating chambers. These procedures are discussed in detail and compared to procedures used by others. (auth)

14688 TRACE ELEMENT DETERMINATION IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Nadkarni, R. A.; Ehmann, W. D. (Univ. of Kentucky, Lexington). pp 407-19 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

Instrumental neutron activation analysis was used to determine thirteen trace elements in biological materials. Two more elements were determined after radiochemical separations. The elements determined included lanthanum, bromine, arsenic, selenium, chromium, silver, scandium, zinc, cobalt, antimony, iron, europium, cesium, gold, and mercury. The samples analyzed included human, canine, and mouse tissues, human blood plasma and serum, about 20 brands of American cigarette tobacco, their smoke condensate and ashes, tobacco pigment, the series of Kentucky Reference Cigarette tobacco, and the biological standard kale. This work illustrates the applicability of instrumental neutron activation analysis to biomedical, nutritional and toxicological studies. (auth)

14689 DETERMINATION OF THE TRACE ELEMENT LEVELS IN ATMOSPHERIC POLLUTANTS BY NEUTRON ACTIVATION ANALYSIS. Pillay, K. K. S.; Thomas, C. C. Jr. (State Univ. of New York, Buffalo). pp 420-32 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

An investigation of the potentials of neutron activation analysis for the routine analysis of trace elements present in atmospheric pollutants is discussed. Various techniques including sequential air sampling, multiple neutron irradiation, high-resolution γ spectrometry, chemical isolation, high-flux neutron irradiation and x-ray spectrometry were employed to determine the levels of Pb, Al, V, I, Cl, Mn, Cu, Br, Na, La, Mo, Au, Cr, Fe, Ni, Se, Zn, Ag, and Co in atmospheric pollutants. The results of the analysis of nearly two hundred samples collected from the Buffalo, New York, area during 1968-69 are reported. (auth)

14690 DETERMINATION OF THE OXYGEN CONTENT OF ALUMINUM BY 14 MeV NEUTRON ACTIVATION RECOIL FROM THE PNEUMATIC TUBE. Dugain, F.; Michaut, C. (Centre de Recherches Pechinev, Voreppe, France). Radiochem. Radioanal. Lett.; 9: No. 2, 119-25(30 Jan 1972).

It was found that recoil from the wall of the pneumatic tube at the irradiation position is responsible for an apparent oxygen content of the sample. Tube materials of Al–Mo alloy coated inside with platinum or gold were found to be the most suitable. (auth)

14691 N-BENZOYL-N-PHENYLHYDROXYLAMINE AS A SUBSTOICHIOMETRIC EXTRACTANT IN ACTIVATION ANALYSIS. III. DETERMINATION OF IRON. Tejam, B. M.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 9: No. 2, 77-84(30 Jan 1972).

A rapid method was developed for the substoichiometric neutron activation analysis of trace amounts of iron based on the selective extraction of iron(III) with N-benzoyl-N-phenylhydroxylamine (BPHA) in chloroform. The iron content of alloys, ores, pure compounds, biological materials, etc. was determined by this method. (auth)

14692 TRACE ELEMENT CONCENTRATIONS IN SOME MODERN CORALS. Livingston, H. D.; Thompson, Geoffrey (Woods Hole Oceanographic Institution, Mass.). Contract AT(30-1)-2174. Limnol. Oceanogr.; 16: No. 5, 786-96(Sep 1971).

Thirty-four scleractinian coral samples, including both hermatypic and ahermatypic varieties, were analyzed for trace elements. Acid leaching was used to infer the distribution of elements between the coral skeleton (acid-soluble fraction) and detrital phases (acid-insoluble). Sr, U, Ba, Cu, B, Li, and Zn are generally present in the coral skeleton. Sr and U concentrations, relative to Ca and to Ca in seawater, show only little discrimination but small variations do exist between species from the same environment, indicating species-specific controls. Larger differences are found between hermatypic and ahermatypic corals. The concentrations of Sr and U are independent of temperature and may be a function of the coral metabolism and rate of skeletogenesis. Ba is not discriminated against, but there is marked discrimination against B and Li. Zn is generally discriminated against but some ahermatypic species show high Zn concentrations. Si, Ti, and Cr are mostly present in the detrital phase associated with the corals; the nature of the detritus often reflects the local environment. Fe, Mn, Co, Ni, Pb, and Sc are distributed variously between the detrital and nondetrital phases. High concentrations are found in ferromanganese-stained pelagic corals and in nearshore corals containing much detritus. The concentrations of these elements in clean, fresh corals indicate that they are discriminated against with respect to Ca uptake from seawater. (auth)

14693 AUTOMATIC ANALYSIS OF GAMMA-RAY SPECTRA AND ITS APPLICATION TO ACTIVATION ANALYSIS. II. Takeuchi, Takayuki; Hayashi, Takeo; Kusaka, Yuzuru. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 4: 63-5(1971).

Application of computer analysis of γ spectra to activation analysis is described for analysis of standard steel samples. Predetermined contents were compared with results from this method. (M.C.G.)

14694 ACTIVATION ANALYSIS INVESTIGATIONS ON STANDARDIZED IRON ALLOYS. II. QUANTITATIVE DETERMINATION OF COPPER, ARSENIC, ANTIMONY, AND LANTHANUM. Gruber, E.; Hecht, F.; Sorantin, H. (Univ., Vienna. Reaktorzentrum, Seibersdorf, Austria). Mikrochim. Acta; No. 5, 794-9(1971). (In German).

The content of copper, arsenic, antimony, and lanthanum was quantitatively determined by neutron activation in the standardized alloys NBS-1138 (CaS + Steel 1) and NBS-1140 (Ductile Iron 1) without destruction and after a rapid group separation by means of an extraction chromatographic method in the system tri-n-octylamine-hydrochloric acid. Certificated values for copper were available in the case of both alloys, but such values were available for arsenic only in one alloy. Our analytical values showed good agreement with the certificated values if the uncertainties are taken into account. In addition with no certificated values, we quantitatively determined antimony and lanthanum in both samples, arsenic in one sample. (auth)

14695 DETERMINATION OF URANIUM, THORIUM, AND SCANDIUM IN BAUXITES AND RED MUDS BY NEUTRON ACTIVATION ANALYSIS. Miskei, M.; Bujdoso, E. Femip. Kut. Intez. Kozlem.; No. 10, 229-35(1971).

Traces of U, Th, and Sc were determined in bauxite and red mud samples by neutron activation. The samples were digested before irradiation. Ion-exchange chromatography was applied to separate the trace elements. It was found that Th and Sc gain access to red mud while some of the uranium dissolves in aluminate liquor during the Bayer process. (Hung. Tech. Abstr.)

14696 EPITHERMAL NEUTRON ACTIVATION ANALYSIS OF URANIUM IN ROCKS. Arroyo, Alfredo; Brune, Dag (Instituto de Asuntos Nucleares, Bogota). Acta Chem. Scand.; 25: 2351-2(1971).

The advantage of the epithermal neutron activation technique is demonstrated by the simultaneous analyses of 10 samples containing 4.5 ± 0.2 ppM U. (Denmark)

14697 USE OF ELECTRONIC COMPUTERS FOR THE INTERPRETATION OF THE SILICON GAMMA SPECTRA. Zinov'ev, N. V.; Mukhamedshina, N. M. (State Scientific-Research and Design Inst. of the Rare Metal Industry, Moscow). Zh. Anal. Khim.; 26: No. 11, 2127-31(Nov 1971). (In Russian).

Modern activation analysis requires the use of sophisticated techniques in the treatment of complex gamma spectra. An algorithm is proposed for computer-handled least squares processing of spectral data, and is used to interpret spectra of samples of silicon containing Au, Zn, Cu, As, Sb, and Ga. Discrepancies in obtaining good evaluation for large values of chi-squared are explained. (K.S.W.)

14698 ON-STREAM NUCLEAR ACTIVATION AND APPLICATION TO URANIUM AND THORIUM. Al-Shahristani, Hussain Ibrahim. Toronto; Univ. of Toronto (1970). National Library of Canada, Ottawa).

Thesis.

A comprehensive mathematical treatment of on-stream activation analysis is presented that includes practical examples of its applications in the determination of trace concentrations of fissionable elements (U and Th). It was shown that liquid solution irradiated and counted simultaneously in a continuous plug flow mode gave rise to the highest count-rate for a given concentration of the element under analysis. Cases of well-stirred and plug flow conditions in the irradiation assembly and laminar and turbulent flow conditions in the transfer line were examined. Continuous and pulsed irradiation and counting arrangements were compared (ratio of count-rates for pulsed to continuous irradiation and counting was 0.25 to 0.37) and the advantages and shortcomings of each system were discussed. The feasibility of trace concentration analysis of uranium and thorium in flow streams was demonstrated using the 14-MeV neutron generator. For this system the optimum irradiation, decay and counting times were calculated to be 60, 37, and 60 sec, respectively. Under these optimal conditions, uranium and thorium concentrations were determined at 20 and 100 ppM, respectively. The minimum detectable concentrations of both elements were limited by the background directly caused by the neutron generator. The interference of the neutron-emitting nuclide ^{17m}O could be reduced to an insignificant level by optimizing the decay time. A facility embodying a laboratory accelerator neutron generator for the continuous on-stream monitoring of fissionable elements was successfully designed and operated. (Diss. Abstr. Int., B)

14699 ACTIVATION ANALYSIS OF SILICON DIOXIDE IN AN IRON ORE CONCENTRATE (EXCHANGE OF EXPERIENCE). Bochenin, V. I.; Shirokii, V. K. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 1, 57-8(Jan 1971).

Translated from Zavod. Lab.; 37: No. 1, 46-7(Jan 1971).

A neutron activation analysis method was developed for the determination of silicon dioxide based on the activity of ^{28}Al from the reaction of slow neutrons with SiO_2. The neutron source with a recording device was set up in an iron ore concentration plant, and chemical analysis was carried out simultaneously with activation determinations of SiO_2 to check the method. The mean deviation of the results of activation analysis from those of chemical analysis was 3 to 4 rel%. (D.H.M.)

Chemical and Spectral Procedures

Refer also to abstract 15026.

14700 (BARC-569) SPECTROGRAPHIC ESTIMATION OF TELLURIUM IN HIGH PURITY SELENIUM AFTER REMOVING SELENIUM BY VOLATILIZATION. Joshi, B. D.; Bangia, T. R.; Dalvi, A. G. I. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 12p. Dep. NTIS (U. S. Sales Only).

An emission spectrographic method for estimation of traces of tellurium in high-purity selenium at ppM concentrations was developed. Tellurium was separated from 1 g of selenium by volatilizing Se from its solution in HNO_3 and H_2SO_4. The residue containing tellurium was dissolved in 200 microliters of 6M HCl and then 50 microliters of this solution were loaded on a 10 mg graphite and sodium chloride mixture contained in the electrode crater. The spectra were excited in a dc arc carrying 13 amp current. Tin was used as an internal standard and NaCl as a carrier. The detection limit for tellurium obtained by this method is 0.4 ppM. The precision of the method is ±7.4%. (auth)

14701 (BARC–574) GAS CHROMATOGRAPHIC SEPARATION OF D_2, O_2, AND N_2 IN HELIUM AND THEIR DETERMINATION. Ramanathan, P. S.; Srivastava, O. P.; Venkateswarlu, Ch. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 14p. Dep. NTIS (U. S. Sales Only).

Employing a simple and inexpensive gas chromatograph, deuterium, oxygen, and nitrogen impurities in helium are separated (Linde Molecular Sieve 5A column) and determined (thermal conductivity detector using thermistors) at 0.05, 0.01, and 0.01% (V/V), respectively, and above. (auth)

14702 (BARC–575) SPECTROGRAPHIC DETERMINATION OF TWENTY-ONE TRACE IMPURITIES IN GRAPHITE. Krishnamurty, G.; Marathe, S. M. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 20p. Dep. NTIS (U. S. Sales Only).

An emission spectrographic method is described for the quantitative estimation of 21 trace impurities in graphite in the range of 0.5 to 500 ppM. Using sodium fluoride as carrier and lanthanum as internal standard, the spectra are excited in a 10-amp dc arc and are recorded on a Hilger large quartz spectrograph in the region 2400 to 3350 Å. The mean standard deviation for various elements varies from 9 to 22%. (auth)

14703 (CEA-N-1479) SEMIANNUAL REPORT OF THE CHEMISTRY DEPARTMENT, NO. 10, JUNE 1970–NOVEMBER 1970. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1971. 402p. (In French). Dep. NTIS (U. S. Sales Only).

This report follows the former one (note CEA-N-1419) and describes, for the period mentioned, the researches made in the different services of the Chemistry Department. It covers chemical analysis, treatment of effluents, treatment of uranium, corrosion and electrochemistry, miscellaneous chemical studies, aqueous reprocessing methods, volatility processing of irradiated fuels, preparation and study of actinides elements, and vitrification of fission products solutions. (France)

14704 (CONF-680423–, pp 271–4) DETERMINATION OF SULFUR IN HYDROCARBONS. Garcia-Moreno C., Carlos (Universidad Nacional Autonoma de Mexico, Mexico City. Laboratorio Nuclear). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The absorption coefficients for H and C coincide at an energy of 23.4 keV and are much lower than the absorption coefficient of S. This fact is the basis of a continuous method for the determination of S in hydrocarbons. A calibration curve was obtained for 1 to 3% S using x rays obtained from the excitation of Ag with ^{241}Am radiation. (J.S.R.)

14705 (EUR–4719) GRAVIMETRIC DETERMINATION OF THE SUM OF URANIUM AND PLUTONIUM IN PRODUCTS OF THE URANIUM–PLUTONIUM–CARBIDE FABRICATION. Angeletti, L. M.; Bartscher, W. J.; Rebizant, J. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). Nov 1971. 14p. Dep. NTIS (U. S. Sales Only). EUR F,Fr. 4.45.

A method for gravimetric determination of the sum of uranium and plutonium in ternary mixtures of U_3O_8–PuO_2–C and in uranium-plutonium mixed carbides is described. The samples are oxidized in a current of air at 900°C and subsequently heated in a current of $CO-CO_2$ (10/1) in order to obtain the dioxides. The whole treatment is performed by an automated apparatus. The standard deviation of the method is 0.035%. (auth)

14706 (EUR–4733) DETERMINATION OF PLUTONIUM CONCENTRATION AND DISTRIBUTION IN URANIUM–PLUTONIUM MIXED OXIDE FUEL BY AUTORADIOGRAPHY AND MICRODENSITOMETRY. Sari, C. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). Oct 1971. 28p. Dep. NTIS (U. S. Sales Only). EUR F,Fr. 4.45.

The plutonium concentration and the homogeneity of the uranium–plutonium oxides, carbides and nitrides was determined by microdensitometric analysis of autoradiographs of the radioactive material examined. The method is based on the fact that the blackening of a film is proportional to the concentration of the radiation emitted from the material. Correct measurements require the use of a reference material and standard curves which are independent of parameters such as exposure time of the film to the α radiations, the development time, inhomogeneities of the film, and errors caused by wrong utilization of the microdensitometer. The plutonium concentration of less than 50% in the solid can be determined with a precision of about 10% and with about 5% for higher concentrations. The microdensitometric measurements can be performed with an accuracy of ±0.25%. The aperture of the apparatus varies from a few μ^2 to a few mm^2. The method allows the concentration determination of any material emitting radiation. The dimensions of segregated particles emitting radiation and their distances can also be determined. Examples of analysis performed on oxides, carbides, and nitrides are reported. (auth)

14707 (K–1880) MASS SPECTROMETER WITH DUAL-APERTURE COLLECTION OF URANIUM ISOTOPES. Sulfridge, C.; Langdon, A. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 29 Dec 1971. Contract W-7405-eng-26. 11p. Dep. NTIS.

A mass spectrometer with a dual-aperture collector assembly is described which simultaneously resolves two uranium isotopes from all others and permits the measurement of the ratio of two specific isotopes. Precise relative measurements of uranium isotopes have been made to assist the Oak Ridge National Laboratory in the analysis of the performance of a molten salt reactor. (auth)

14708 (KFK–1299) ACCURACY OF CALORIMETRIC PLUTONIUM DETERMINATIONS. Weitkamp, C.; Beisswenger, H.; Schneider, V. W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Sep 1971. 6p. (CONF-710940–2). Dep. NTIS (U. S. Sales Only).

From International meeting on nondestructive measurement and identification techniques in nuclear safeguards; Ispra, Italy (20 Sep 1971).

The main sources of error in the nondestructive assay of plutonium by calorimetric methods are: errors in the measurement of the power output of the sample, errors in the isotopic composition, and uncertainties of the specific power of the isotopes involved. An estimate of the effect of the different error sources upon the overall accuracy shows that, depending on the composition of the sample material, each of the three can account for the largest error contribution. (auth)

14709 (NIM–1145) USE OF 2-(2-PYRIDYLAZO)-5-DIETHYLAMINOPHENOL AS A SPECTROPHOTOMETRIC REAGENT FOR THE DETERMINATION OF URANIUM. Cook, E. B. T.; Gereghty, Anna (National Inst. for Metallurgy, Johannesburg (South Africa)). 11 Jan 1971. 22p. Dep. NTIS (U. S. Sales Only).

The practical details of the preparation of 2-(2-pyridylazo)-5-diethylaminophenol were investigated, and a supply of the reagent prepared having similar characteristics to that prepared by Florence, et al. The liquid–liquid-extraction method of Florence, et al., using TOPO in cyclohexane was applied to the analysis of uranium obtained by acid extraction as well as to that obtained by fusion of the sample or of the residue of the sample after acid extraction with boric oxide. The method was found, as claimed, to eliminate interference effects from the associated elements. The direct method proposed by Florence, et al., for the analysis of uranium in solutions was, however, not successful when applied to acid extracts of Witwatersrand ores. The interference effects of the associated elements were investigated for the direct method, and means of overcoming these were proposed. These include the omission of sodium fluoride as a complexing agent, an alteration in the order in which the reagents are added to avoid interference from aluminum, and the use of a compensating blank to correct for interference from iron. When the modified method was applied, the results obtained for standard samples were in good agreement with the accepted values and those obtained by the extraction method. Interferences from PO_4^{3-}, As^{5+}, V^{5+}, and Cr^{3+} still persist, and suggestions have been put forward for their elimination. Interferences from these elements are unlikely to be encountered when Witwatersrand ores are being analyzed. The relative merits of the methods (their precision, sensitivity, and speed) compared with the extraction method using tributyl phosphate are discussed. (auth)

14710 (NIM–1318) THE DETERMINATION, BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY, OF OSMIUM AND IRIDIUM IN SOLUTION. Mallett, R. C.; Breckenridge, R. L. (National Inst. for Metallurgy, Johannesburg (South Africa)). 22 Sep 1971. 10p. Dep. NTIS.

Tests had shown that interferences in the determination of osmium and iridium by atomic-absorption spectrophotometry can be removed or reduced by the addition of uranium or vanadium as a releasing agent. These two elements can be determined by the atomic-absorption methods already developed for the determination of the other noble metals—osmium in a nitrous oxide–acetylene flame and iridium in an air–acetylene flame. However, these elements have to be present in the final solution for measurement in the following concentrations: osmium above about 5 ppM, and iridium above about 1 ppM. (auth)

14711 (NIM–1322) PREPARATION AND ANALYSIS OF MINERALS FOR USE AS REFERENCE MATERIAL. Progress Report No. 1. Stoch, H.; Summerson, Colleen D.; Theron,

Mariana (National Inst. for Metallurgy, Johannesburg (South Africa)). 21 Sep 1971. 17p. Dep. NTIS (U. S. Sales Only).

A list of the samples collected and a description of their preparation are presented. Samples containing Mo, Th, Sn, Be, Cs, Ta, and Nb are discussed. (M.C.G.)

14712 (ORNL-4742) SPECTROCHEMISTRY AND SPECTRUM RESOLUTION OF SOME IODINE SPECIES IN ACIDIC, NEUTRAL, AND BASIC SOLUTIONS. Davis, W. Jr.; Kibbey, A. H. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 51p. Dep. NTIS.

Spectra of various species of iodine in acidic, neutral, and basic solutions (from 3M HNO_3 to 1M NaOH) were recorded over the wavelength region 190 to 700 nm. These spectra could be fit to the model of a series of overlapping bands of Gaussian shape within the stated limit of accuracy of the Cary 14R spectrophotometer. Regardless of whether the bands are of this, or a more complicated, shape, the model allows a portion of the measured absorption to be related to a specific ionic or molecular component, such as I^-, I_3^-, and $I_2 \cdot aq$, in a more quantitative manner than has been done previously. The model was used to provide tabular values of molar absorptivities and to initiate the formation of a "library" of standard spectra. This library should find application in the determination of the ionic and molecular structures of various iodine (and other) species in solution just as the standard gamma spectra are useful for determining, by spectrum resolution, how much of each of many gamma-emitting nuclides is present in a solution. In addition to providing some standard spectra, the present study cast doubt on the accuracy of a textbook method for preparing hypoiodous acid (HOI). Also presented are results of the conversion of I^- to I_2 in nitric acid solution, of I_2 to I^- in basic solution, and of other species, probably including hypoiodite ion (IO^-), to additional, unidentified components. (auth)

14713 (RFP-Trans-90) DIRECT POTENTIOMETRIC CONCENTRATION DETERMINATION WITH ION-SENSITIVE ELECTRODES USING COMPLEXING AUXILIARY REACTIONS. Oehme, Friedrich; Dolezalova, Ludmilla. Translated for Dow Chemical Co., Rocky Flats Div., from Z. Anal. Chem.; 251: 1-6(1970). 13p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 41196.

14714 (RFP-Trans-91) SIMULTANEOUS DETERMINATION OF ALUMINUM AND IRON IN PLUTONIUM. Motojima, Kenji; Yamamoto, Tadashi; Muto, Hiroshi; Kato, Yoshiharu. Translated for Dow Chemical Co., Rocky Flats Div., from Jap. Anal.; 19: 1091-3(Aug 1970). 7p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 43954.

14715 (Y-1812) DETERMINATION OF TUNGSTEN BY SOLVENT EXTRACTION AND ATOMIC ABSORPTION SPECTROSCOPY. Morrow, R. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 11 Jan 1972. Contract W-7405-eng-26. 11p. Dep. NTIS.

A method is described for determining 25 to 1,000 $\mu g/g$ quantities of tungsten in tantalum by solvent extraction and atomic absorption spectroscopy. The tungsten is complexed with toluene-3, 4-dithiol (4-methyl-1, 2-dimercaptobenzene) and extracted into butyl acetate. The extract is nebulized into a nitrous oxide–acetylene flame, and the tungsten content determined by the atomic absorption at 2,551.4 A. Ten samples (two aliquots each) can be analyzed in six hours. The relative limit of error for a single determination by the proposed procedure under routine laboratory conditions is ±9.5% (95% confidence level). (auth)

14716 STUDIES ON SPECTROCHEMICAL ANALYSIS OF RARE ELEMENTS. X. COMBINED SOLVENT EXTRACTION-SPECTROCHEMICAL METHOD FOR THE DETERMINATION OF TRACE NON-RARE EARTH ELEMENTS IN CERIUM DIOXIDE. Osumi, Yasuaki; Kato, Akihiko; Miyake, Yoshizo (Government Industrial Research Inst., Osaka). Jap. Anal.; 20: No. 11, 1393-7 (Nov 1971). (In Japanese).

An emission-spectrographic method is described for the quantitative determination of traces of non-rare earth elements separated from cerium dioxide by solvent extraction. A 1.0 g sample of cerium dioxide is dissolved in a mixture of 5 ml of concentrated nitric acid and 5 ml of 30% hydrogen peroxide. The solution is evaporated to dryness. The residue is dissolved in 50 ml of 9N nitric acid containing 0.20 g of sodium bromate. The solution is extracted twice with 50 ml portions of tributyl phosphate. The aqueous layer is mixed with 0.10 g graphite powder, evaporated to dryness and finally heated at 500°C. To the residue thus obtained is added 10 ppM of gallium as an internal standard. A weighed portion of this is placed on the sample electrode and packed lightly with a venting tool, and is discharged by dc arc. Recovery of impurity elements in the proposed analytical procedure was: 130% for Al and Mg; 90 to 110% for Ag, Ca, Co, Cu, Mn, Ni, Pb, and Sn; 50 to 85% for Bi, Fe, and Ti. Analytical values of impurities in the sample were corrected by the correction factor obtained from the recovery. The proposed method enables the determination of microquantities of 13 impurity elements in cerium dioxide down to 0.2$_5$ ppM for Mg and Mn; 0.5 ppM for Ag, Bi, and Cu; 2.5 ppM for Al, Ca, Fe, Ni, Pb, and Sn; 5.0 ppM for Co; 12.5 ppM for Ti. Coefficients of variation are less than 15%. (auth)

14717 COULOMETRIC TITRATION OF LANTHANUM WITH ELECTROCHEMICAL GENERATION OF FLUORIDE ION. Lee, Yong Keun (Tokyo Univ.); Whang, Kyu Ja; Nozaki, Ken; Muto, Giichi. Jap. Anal.; 20: No. 11, 1441-6(Nov 1971). (In Japanese).

Lanthanum was titrated with a constant-current coulometric method to form a complex with fluoride ions generated through a europium-doped lanthanum fluoride single crystal membrane. The fluoride ion activity electrode was applied to the fluoride ion generating electrode. The effective area of the lanthanum fluoride single crystal is about 0.8 cm^2. The catholyte (1M NH_4F–HF) was circulated into the generating electrode to feed the fluoride ion, and a platinum wire cathode was fitted to it. A piece of platinum wire was applied to the counter electrode, and saturated potassium nitrate was used as anolyte. A membrane of cation exchange resin was used to the counter electrode chamber to prevent leakage of fluoride ion. The endpoint was detected potentiometrically with another fluoride ion activity electrode and a saturated calomel electrode with salt bridge was used for reference electrode. The 0.4 to 1.4 mg of lanthanum as chloride was titrated by this method with 1.6 to 2.5% of relative standard deviation. The current efficiency was 100.7 ± 1.6% at 15 mA/cm^2. Lanthanum could be titrated over again without exchange of the electrolyte, until the electrolyte was extremely diluted with the sample solutions. The arrangement of the electrodes affected the titration curves, because the generating current caused electrical field in the electrolyte. The current efficiency was determined for 9 to 30 mA/cm^2, but high current density, such as 15 mA/cm^2, caused damage of the lanthanum fluoride membrane, and too long a titration time was needed at low current density. This method is expected to have applications to other cations that form stable fluoride complexes and other ion selective electrodes may be also applied to the specific ion generating electrode. (auth)

14718 DETERMINATION OF ORGANIC IODINE USING MICRO CARIUS' METHOD WITH SILVER BOAT. Honma, Haruo; Yoshida, Mutsuko; Suzuki, Keiko (Inst. of Physical and Chemical Research, Saitama, Japan). Jap. Anal.; 20: No. 11, 1447-52(Nov 1971). (In Japanese).

In microdetermination of organic halogen using a silver boat, chlorine and bromine are determined satisfactorily but an excess of silver causes a large negative error in analysis of iodine. The stability of silver iodide in hot fuming nitric acid, the effect of an amount of silver on the recovery of iodine, the reduction of silver iodate to iodide, a suitable weight of silver boat, heating time, and other analytical conditions were investigated. Silver iodide was unstable in hot fuming nitric acid and produced silver iodate or liberated iodine. Silver iodate dissolved slightly in nitric acid solution and the recovery of silver iodide decreased in proportion to the amount of added fuming nitric acid. By an addition of silver, the recovery of it increased, but it decreased again when silver was added in a large excess. It was assumed that a complex was formed by absorption of the excess silver ion on silver iodide precipitates and that it dissolved in nitric acid solution. Various amounts of silver (10 to 35 mg) were used in order to determine the adequate weight of the silver boat that made the negative error minimum, and 25 mg was found to be appropriate. The most suitable conditions are as follows. About 4 mg of sample is weighed in a silver boat of 20 to 25 mg and put it into a sealed glass tube. After an addition 0.5 ml of fuming nitric acid, the whole is heated at 310 to 320°C for 3 hours. Then 5 ml of distilled water is added and heated on a boiling water bath for 90 minutes. After cooling to the room temperature, 2 ml of 1M sodium nitrite solution is added and heated on a water bath for 120 minutes. Then the precipitate was filtered, dried, and weighed. By this method good results were obtained for the determination of iodine in standard σ-iodobenzoic acid and iodoform. (auth)

14719 DETERMINATION OF ALUMINUM, COBALT, CHROMIUM, COPPER, IRON, MANGANESE, MOLYBDENUM, NICKEL, TIN, AND VANADIUM IN TITANIUM ALLOYS BY ATOMIC ABSORPTION SPECTROMETRY. Kudo, Yutaka; Hasegawa, Nobuhiro; Yamashita, Takashi (Kobe Steel Ltd., Japan). Jap. Anal.; 20: No. 10, 1319-21(Oct 1971). (In Japanese).

An accurate and rapid atomic absorption analysis for the de-

termination of 10 alloying elements in titanium alloys was studied. The apparatus employed was a Nippon-Jarrell Ash AA-1 type with water-cooled fish tail burner (0.5 × 50 mm) and grating blazed at 3000 Å. The samples (0.1 g) were dissolved in H_2SO_4, HF, and HNO_3, and the solution was evaporated until it fumed. The solution was diluted to a determined volume according to elements and/or their contents. The flame used is either air–C_2H_2 for Co, Cu, Fe, Mn, and Ni or N_2O–C_2H_2 for Al, Cr, Mo, Sn, and V. The absorptions measured are given in rectilinear calibration curves. The coefficient of variation ranges from 0.4 to 2.8%. The method is comparable in accuracy to the conventional wet chemical analysis, but faster. (auth)

14720 EMISSION-SPECTROMETRIC DETERMINATION OF TRACE RARE EARTH ELEMENTS IN EUROPIUM OXIDE. Osumi, Y. (Government Industrial Research Inst., Osaka); Miyake, Y.; Imahara, K. Z. Anal. Chem.; 256: No. 3, 182-7 (1971).

A dc arc excitation method in a controlled atmosphere was applied in the presence of CsCl–graphite (1 : 9) buffer for the quantitative determination of traces of rare earth elements in europium oxide. The intensities of the cyanogen band spectra and the background could be reduced by the use of argon–oxygen (4 : 1) mixed gas atmosphere and it was possible to obtain higher sensitivity than in the excitation in air. Addition of CsCl–graphite buffer caused an increase of the evaporation rate of the sample and of the number of atoms in the arc plasma, and the atoms and ions of rare earths distribute uniformly along the axis of the discharge gap. The buffer enhances the sensitivity and reproducibility and permits determination of microquantities of 10 impurity elements within limits of detection from 3 to 11 ppM in high-purity europium oxide. The coefficients of variation are less than 13%. (auth)

14721 DETERMINATION OF TRACES OF URANIUM BY RADIOISOTOPE ENERGY DISPERSIVE X-RAY (EDX) ANALYSIS. Bertrand, C. C.; Linn, T. A. Jr. (Kennecott Copper Corp., Salt Lake City, Utah). Anal. Chem.; 44: No. 2, 383-4(Feb 1972).

A rapid and relatively simple method for the determination of U in a variety of aqueous samples, including ground water, acid process solutions, and mine water, was developed. Barium sulfate in the presence of potassium is used for the quantitative separation of uranium. Radioisotope EDX analysis or conventional x-ray spectrometry may be used for the determination of the separated uranium. The separation procedure effectively removes all interfering elements except actinides, which occur rarely in the samples studied. (J.G.B.)

14722 RAPID PHOTOCHEMICAL DETERMINATION OF URANIUM(VI) AT TRACE LEVELS. Riggs, William M. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Anal. Chem.; 44: No. 2, 390-1(Feb 1972).

Uranium is determined by a new method based upon photoreduction of uranium(VI) to uranium(IV) with a primary or secondary aliphatic alcohol. The U(IV) is then treated with excess iron (III), and the iron(II) produced is colorimetrically determined with orthophenanthroline. This method has all the advantages of the best earlier photochemical methods and is significantly more convenient and sensitive. It has the further advantages of not being critically dependent on sulfuric acid concentration or on close control of irradiation time, geometry, or intensity. (J.G.B.)

14723 COULOMETRIC MICRODETERMINATION OF NEODYMIUM USING FEEDBACK-CONTROLLED ELECTROLYSIS CURRENT. McCracken, J. E.; Guyon, J. C. (Univ. of Missouri, Columbia). Anal. Chem.; 44: No. 2, 305-8(Feb 1972).

Methods were developed for the coulometric, complexometric microdetermination of neodynium using feedback-controlled electrolysis current. Determinations were made in a machined Teflon microcoulometric cell that used a mercury pool generating electrode and a Pt(Hg) indicator electrode. The intermediate electrolyte was an ammonium acetate buffer solution containing $Na_2HgEDTA$. Three different techniques were studied and compared using this chemical system. The optimum technique exhibited a standard deviation of 0.3 μg in the sample range 1.2 to 170 μg of neodymium. (auth)

14724 IMPROVED AMPEROMETRIC PROCEDURE FOR DETERMINING PLUTONIUM. Hedrick, Charles E.; Pietri, Charles E.; Wenzel, Albert W.; Lerner, Morris W. (Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem.; 44: No. 2, 377-8(Feb 1972).

The interference of Ce, Cr, and Mn in the determination of Pu by a method involving its oxidation with perchloric acid and subsequent titration is eliminated by selective reduction before titration with arsenite and osmium(VIII) catalyst. Vanadium can be tolerated in amounts up to 250 ppM. (J.G.B.)

14725 TECHNIQUE FOR DETERMINATION OF HEAVY ELEMENT IMPURITIES IN TARGETS. Close, D. A.; Bearse, R. C. (Univ. of Kansas, Lawrence). Nucl. Instrum. Methods; 97: No. 3, 607-8(1971).

A method is presented which allows the identification in deposition targets of contaminants for which $Z \geq 20$. The method is based on heavy ion-induced x-ray fluorescence. (auth)

14726 SPECTROPHOTOMETRIC DETERMINATION OF GADOLINIUM WITH 4-(2-PYRIDYLAZO)RESORCINOL. Ueda, Joichi (Kanazawa Univ., Japan). Nippon Kagaku Zasshi; 92: No. 10, 849-52(Oct 1971). (In Japanese).

Gadolinium reacts with 4-(2-pyridylazo) resorcinol (PAR) to form a water-soluble orange–red complex. The absorption maximum of the colored solution is at 516nm, and the absorbance is constant over the pH range from 10.1 to 10.7. The reaction is very sensitive to the amount of gadolinium and the molar extinction coefficient of the complex is 8.89×10^4, and Beer's law is obeyed up to 1.4 μg/ml of gadolinium. The composition of the complex was determined at pH 10.2 as $Gd(PAR)_3$ by the method of continuous variation. Many ions interfere with the determination, but magnesium, calcium, strontium, and barium can be masked by addition of sodium acetate, and copper, manganese, iron(III), cobalt, nickel, and palladium by potassium cyanide. Beryllium is also masked by sulfosalicylic acid, and tin(IV), lead, bismuth(III), zinc, cadmium, and mercury(II) by thioglycollic acid. Indium, chromium(III), tungsten(VI), scandium, yttrium, and other rare earth metals interfere seriously. (auth)

14727 ANALYSIS OF DEUTERIUM CONTENT OF HYDROGEN AT AND BELOW NATURAL ABUNDANCE LEVELS. Fisher, I. P.; Brown, W. F. (Gulf Oil Canada Ltd., Sheridan Park, Ont.). J. Mass Spectrom. Ion Phys.; 7: No. 4, 273-9(Oct 1971).

Some simple modifications to a small commerical mass spectrometer are described which enable HD/H_2 isotope ratios to be determined in hydrogen streams with a standard deviation of 2.9 ppM at the 95% confidence level. Differences in isotope ratios between feed and processed hydrogen streams were determined with a standard deviation of 2.3 ppM. The system has been used to determine both absolute ratios and enrichment values from about 10 ppM up to natural abundance levels of deuterium in hydrogen. (auth)

14728 INDIRECT VOLTAMMETRIC DETERMINATION OF POTASSIUM AND CESIUM AND DIRECT AMPEROMETRIC DETERMINATION OF POTASSIUM WITH TETRAPHENYLBORATE USING SILICONE RUBBER BASED GRAPHITE ELECTRODES. Siska, E. (Inst. for Food Control and Chemical Analysis, Szekesfehervar, Hungary); Pungor, E. Z. Anal. Chem.; 257: No. 1, 7-11 (1971).

The electrochemical oxidation of tetraphenyl borate ions was investigated by using a silicone rubber-based graphite electrode. An indirect voltammetric method was developed for the determination of potassium and cesium. A method is also given for the determination of potassium with sodium tetraphenylborate by using amperometric end-point indication. The latter method is more accurate. The relative standard deviation is ±0.85%. (auth)

14729 TOTAL RARE EARTH DETERMINATION BY AN EXTRACTION–SPECTROPHOTOMETRIC METHOD. Kirillov, A. I.; Makarenko, O. P.; Blasov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 14: No. 10, 1479-82(1971). (In Russian).

An extraction-spectrophotometric method for rare earth assay in ores was investigated, based on a ternary colored complex of rare earth–Arsenazo III–diphenylguanidine. A scheme for the preliminary removal of interfering elements in the form of their rhodanide complexes in a 0.1 M solution of diantipyrilmethane (4,4′-methylenediantipyrine) in $CHCl_3$ is described. The sensitivity of the method is 0.07 μg total rare earths/10 ml of solution, and between 0.07 to 30.0 μg/10 ml there was observed a compliance with the Bouguer-Lambert-Beer law. (K.S.W.)

14730 REACTION OF HOLMIUM WITH ALIZARIN S AND AMMONIA. Serdyuk, L. S.; Dovgal, B. I. (Dnepropetrovsk State Univ., Makhachkala, USSR. Chernovits State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 14: No. 10, 1474-8(1971). (In Russian).

Complex compound formation between Ho, NH_3, and Alizarin S (in the ratio 1 : 2 : 5) was investigated for possible use in photometry. The sulfoalizarin complex was formed best in the pH interval 9.7 to 10.1, and had an absorption maximum at 520 to 530 nm. Its suggested formula is $Ho(Aliz)_3 \cdot 2\ NH_4(Aliz)$, and its application to the photometric determination of Ho is indicated. (K.S.W.)

14731 H/D RATIO MEASUREMENT WITH MI-1305-TYPE MASS SPECTROMETER BY COMPENSATION TECHNIQUE. Matus, Lajos; Opauszky, Istvan. Magy. Kem. Foly.; 77: No. 8, 387-90(Aug 1971). (In Hungarian).

A method is described by which a mass spectrometer, in which

the distance between the focal points for mass numbers 2 and 3 is greater than the spacing of the two ion collectors, can be employed for high accuracy determination of H/D ratios by means of compensation technique. The spacing problem is overcome by pulsing the accelerator voltage in such a way that the ions of mass number 2 strike the collectors at a higher (3-kV) accelerating voltage than those of mass number 3 (~2.5 kV). The electrometer measuring mass number 3 is made more sensitive than that which measures those of mass number 2 also by using 3-kV pulses of longer duration than the 2.5-kV pulses. The voltage outputs from the collector current amplifiers are compared by compensation technique. A reference standard has to be used. H/D ratios can be measured in this way to an accuracy of ±0.3%. (auth)

14732 MASS SPECTROMETRIC DETERMINATION OF THORIUM IN THE ppm-RANGE IN URANIUM ORES BY ISOTOPIC DILUTION ANALYSIS. Heumann, K. G.; Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Z. Anal. Chem.; 257: No. 1, 18-22(1971). (In German).

Thorium is chemically separated from uranium ores in a nonquantitative way. In one sample the isotopic ratio $^{230}Th/^{232}Th$ is determined in a mass spectrometer. In another sample ^{230}Th is added as indicator for the isotopic dilution; the thorium of this particular sample is also analyzed in a mass spectrometer. The content of ^{230}Th and ^{232}Th is calculated from the measurements of the isotopic ratios and the amount of the ^{230}Th indicator. The results are compared with the results obtained by other methods. (auth)

14733 ATOMIC ABSORPTION SPECTROSCOPY OF SELECTED METALS IN A METHYL ISO-BUTYL KETONE/WATER/8-HYDROXYQUINOLINE SOLVENT EXTRACTION SYSTEM. Windham, Ronnie Lynn. College Station, Tex.; Texas A and M Univ. (1971). 88p. University Microfilms Order No. 71-24,716.

Thesis.

The methyl isobutyl ketone–water–8-hydroxyquinoline solvent extraction system coupled with atomic absorption spectroscopy was studied with regard to its applicability to the determination of some thirteen metals. The system was found to give satisfactory results for Cd, Co, Cu, Fe, Pb, Mn, Ni, and Zn. The system was found to give poor results with Cr, Mg, Ca, and Sr. Analysis of the organic extract was found to enhance the sensitivity with respect to that in aqueous solution by the following multiples: Cd–1.8; Co–3.9; Cu–2.2; Fe–2.7; Pb–2.2; Mn–4.6; Ni–3.8; and Zn–1.8 times. Extraction of the various metals was found to be complete or nearly complete for the pH ranges: Cd, 8.2 to 8.8; Co, 6.0 to 8.0; Cu, 3.1 to 14.0; Fe, 2.2 to 4.8; Pb, 7.4 to 14.0; Mn, 8.6 to 11.6; Ni, 4.6 to 7.5; and Zn, 5.8 to 8.7. The system was found to be well adapted to the separation, concentration, and determination of small traces of metals from complex aqueous solution at controlled pH. (Diss. Abstr. Int., B)

14734 SPECTROCHEMICAL METHOD OF QUANTITATIVE DETERMINATION OF RARE EARTH ELEMENTS IN CARBONATE MINERALS. Tarnovskaya, A. N.; Plyushch, G. V. Vestn. Leningrad. Univ., No. 10, Fiz., Khim.; No. 2, 149-52(May 1971). (In Russian).

The spectrochemical method of determination of Y, La, Ce, Nd, and Pr in calcite, dolomite, siderite, and ankerite is suggested. The use of Sb_2S_3 as a "buffer" reduces the time of evaporation of rare earth elements. The ac arc is used in the atmosphere of CO_2. (auth)

14735 NEW REAGENT FOR QUANTITATIVE DETERMINATION OF THE PLATINUM METALS. Kukushkin, Yu. N.; Simanova, S. A.; Alashkevich, V. P.; Bakhireva, S. I. J. Appl. Chem. USSR (Engl. Transl.); 44: No. 7, 1657-9(Jul 1971).

Translated from Zh. Prikl. Khim.; 44: No. 7, 1640-2(Jul 1971).

Thioacetamide is a group reagent for quantitative separation of all platinum metals in sulfide form from aqueous solutions. It can also be used for quantitative determination of individual platinum metals. Thioacetamide is of special interest as a reagent for determination of rhodium, iridium, ruthenium, and osmium. (auth)

14736 DETERMINATION OF IRIDIUM IN PRECIPITATES WITH TETRAPHENYLARSONIUM CHLORIDE BY SPECTROPHOTOMETRIC COLORIMETRY. Nagy, Ladislao (Kernforschungszentrum, Karlsruhe, Ger. Univ. Nacional, Asuncion). Rev. Soc. Cient. Paraguay; 11: No. 1-2, 31-3(1970). (In Spanish).

A method is reported for spectrophotocolorimetric determination of iridium in precipitates with tetraphenylarsonium chloride. It is possible to confirm the factor suggested by Neeb previously and to obtain a good procedure for determining yields of radioactive iridium. (auth)

14737 INTERACTION OF THE RARE EARTH IONS WITH ERIOCHROMECYANINE R AND 1,10-PHENANTHROLINE. Poluektov, N. S.; Melent'eva, E. V.; Sandu, M. A.; Lauer, R. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 26: No. 12, 2354-9(Dec 1971). (In Russian).

It was established that the rare earth ions form three-component complex compounds with Eriochrome Cyanine R and 1.10-phenanthroline at a ratio Me : ECC : Phen = 1 : 2 : 1. The coordinating ion $MeOH^{2+}$ displaces one proton from each Eriochrome Cyanine molecule on the complex formation. The formation constants for La, Ho, Yb, and Y complexes were calculated. A photometric method was developed for determining the rare earths of the yttrium subgroup in the presence of the cerium subgroup elements with a sensitivity down to 0.5% of Me_2O_3. The mean error of the determination is not greater than 2.14%. (auth)

14738 ANALYTICAL CHEMISTRY OF URANIUM(III). COMMUNICATION 2. PHOTOMETRIC DETERMINATION OF URANIUM(III) BY DECOLORIZATION OF ACID YELLOW METHANYL. Nemodruk, A. A.; Poloznikova, E. I.; Myasoedov, B. F. Zh. Anal. Khim.; 26: No. 12, 2388-94(Dec 1971). (In Russian).

A method for determining small amounts of uranium was developed. It is based on the reduction of Acid Yellow Methanyl by uranium(III). The molar extinction coefficient estimated with respect to uranium is 1.1×10^3. No interference to uranium determination is caused by elements that are not reduced by zinc amalgam, and also by Cu, Hg, Ag, Au, platinum metals, Fe, Sn, Tl, Ce and some others. Only chromium and vanadium interfere as they are reduced together with uranium to lower valence states and reduce Acid Yellow Methanyl as well as uranium(III). (auth)

14739 AZO COMPOUNDS ON THE BASIS OF RHODANINE AND THIORHODANINE AS REAGENTS FOR THE PHOTOMETRIC DETERMINATION OF GOLD, SILVER, AND PLATINUM ELEMENTS. Propistsova, R. F.; Savvin, S. B.; Rozovskii, Yu. G. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 26: No. 12, 2424-33(Dec 1971). (In Russian).

Azo derivatives of rhodanine and thiorhodanine give contrasting and sensitive color reactions with platinum, gold, and silver over a wide acidity range. No interference in Pt, Au, and Ag determination with sulfochlorophenol azorhodanine is caused by other elements of the platinum group (palladium interferes in the case of silver). Large amounts of Fe, Ni, Co, Cu, Pb, Hg, Zn, Al, Th, Zr, Ca, Ba, Mg, and other elements do not interfere with the determination. The determination of Pt, Au, and Ag with the use of one reagent without preliminary separation and masking is based on the difference in the rate of color development and on the interaction conditions. (auth)

14740 PHYSICO-CHEMICAL PROCESSES DURING THE DETERMINATION OF OXYGEN IN METALS BY THE ISOTOPE-DILUTION METHOD. COMMUNICATION 2. DISTRIBUTION OF OXYGEN IN THE REACTION SYSTEM AMONG GAS, LIQUID, AND SOLID PHASES. Saksonova, L. N.; Burtsev, V. T. (Inst. of Metallurgy, Moscow). Zh. Anal. Khim.; 26: No. 12, 2441-5(Dec 1971). (In Russian).

Heterogeneous isotope exchange was found to be absent in the system, gas–solid body (quartz, graphite, stainless steel). The different intensity of $^{12}C^{16}O$ and $^{12}C^{18}O$ feed into the gas phase, the kinetic slowing-down with time of the gas liberation, and also the different rates of adsorption of gas constituents causing a decrease of partial pressure during the analysis of $^{12}C^{18}O$ and the increase of the $^{12}C^{16}O$ analysis. The optimum time of the isotope balancing during the oxygen determination in Ni, Nb, Mo, and also in Mo containing dispersed inclusions of refractory oxides by the isotope-dilution method with the use of a nickel blank bath and dosed Nb samples is 2 to 4 min. (auth)

14741 USE OF SPARK MASS SPECTROMETRY FOR DETERMINATION OF GASEOUS IMPURITIES IN METALS BY THE METHOD OF ISOTOPE DILUTION. Glawin, G. G.; Kopezky, C. W.; Nikolaev, R. K.; Sicharulidze, G. G. (Inst. of Solid State Physics, Moscow). J. Less-Common Metals; 26: No. 1, 1-7(Jan 1972). (In German).

The application of mass spectrometry to the estimation of gaseous impurities in metals, using the isotope-dilution method, was examined. It is calculated that the method, applied to the estimation of nitrogen in metals, shows the possibility of carrying out this analysis to 1×10^{-5} at.% with a precision of 10 to 15%. (auth)

14742 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM(III) USING DIPHENYLCARBAZONE. Bhatia, P. G.; Manku, G. S.; Bhat, A. N.; Jain, B. D. (Univ. of Delhi). Mikrochim. Acta; No. 5, 788-93(1971).

The purple violet ruthenium(III)–diphenylcarbazone complex that is formed at p_H 5 to 7, and has an absorption maximum at 530 nm with molar absorption coefficient 16.2×10^4 l cm^{-1} $mole^{-1}$ is suggested for the estimation of 20 to 125 μg ruthenium(III) spec-

trophotometrically in 30 to 60% ethanol. The complex is stable over p_H range 3.2 to 8.4. The limits of interference due to foreign ions were studied. (auth)

14743 SPECTROPHOTOMETRIC DETERMINATION OF MICROAMOUNTS OF MANGANESE WITH SALICYLIC AND ACETYLSALICYLIC ACIDS. Henriques, H. P.; Hainberger, L.; Grupe, S. J.; Grupe, H. (Univ. Catolica, Rio de Janeiro). Mikrochim. Acta; No. 5, 807-10(1971). (In German).

A method of spectrophotometric determination of Mn is described. One to 2.5 ml of the test solution was treated with 3 ml of 0.58M solution of salicylic acid or acetylsalicylic acid in 10% ammonia and 1 ml of 5% perhydrol are added. After 2½ hours the volume is completed to 100 ml with 10% ammonia. Extinction is measured at 385 nm. The law of Lambert–Beer is obeyed between 0.005 μg and 0.0125 μg/ml. Interfering elements include Fe, Cr, Cu, Co, Th, and U. (auth)

14744 INFLUENCE OF THE SIMULTANEOUS FORMATION OF DIFFERENT METAL-INDICATOR COMPLEXES ON THE ACCURACY OF PHOTOMETRIC COMPLEX-FORMATION TITRATIONS. Kragten, J. (Univ., Amsterdam). Mikrochim. Acta; No. 5, 821-37(1971).

Metals and indicators usually form more than one complex in solution. Besides the complexes MI and MI_2, M_2I and M_2I_2 are also known. When one of the latter two predominates in solution, systematic deviations can theoretically be expected in chelatometric titrations of micromole amounts. This was confirmed experimentally in titrations of Fe, Bi, and Th with EDTA by using triphenylmethane dyes such as Xylenol Orange and Chromazurol S (CAS) as indicator. When titrations are performed with indicators which predominantly form MI_n, as indicators of the azo type do, accurate results have experimentally been found in agreement with the theory. When such an indicator is not available, a proper wavelength selection will sometimes improve the accuracy, but in most cases back-titrations are preferable. (auth)

14745 ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF BIVALENT TELLURIUM WITH PYRROLIDINECARBODITHIOIC ACID. Hayashi, Kenjiro; Ito, Kyoko (Yamaguchi Univ., Yoshida, Japan). Jap. Anal.; 20: No. 12, 1550-4 (Dec 1971). (In Japanese).

Bivalent tellurium, Te(II), forms a sparingly soluble precipitate with pyrrolidinecarbodithioic acid (PDTC) in acidic solution. Although the precipitate dissolves in methyl isobutyl ketone and other organic solvents, the extraction-spectrophotometry is undesirable because both Te(II)–PDTC complex and a fraction of PDTC are extracted at the same time and absorb the light at ultraviolet region. However, Te(II) reacts with PDTC to form a water-soluble complex in the presence of surface active agent such as Triton X-100 (alkylaryl polyether alcohol), as the Te(II)-PDTC precipitate dissolves easily in pure Triton X-100. Therefore, it can be assumed that the formation of clean solution in the presence of Triton X-100 is due to the dissolution of the complex into the micelles of Triton X-100. A procedure for the determination of trace of Te(II) is described. (auth)

14746 SUCCESSIVE COLORIMETRIC DETERMINATION OF SMALL AMOUNTS OF COBALT, COPPER, AND NICKEL. Kuroha, Toshiaki (Furukawa Electric Co., Ltd., Tokyo). Jap. Anal.; 20: No. 12, 1565-9(Dec 1971). (In Japanese).

Successive colorimetric determination of Co, Cu, and Ni is presented. Cobalt is not extracted into dilute nitric acid from the solvent containing its diethyldithiocarbamate, while other metal chelates are extracted. Copper has a greater chelate formation constant with the carbamate than Ni and Pb, and gives selectively a substitution reaction with Pb in the complex in the solvent, while Ni does not. The recommended procedure applying to the analysis of these metals in aluminum metal and aluminum–uranium alloy is described. The limit of determination for cobalt and copper was 1 μg and that for nickel was 2 μg. (auth)

14747 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH ERIOCHROME CYANINE R IN THE PRESENCE OF CETYLTRIMETHYLAMMONIUM BROMIDE. Otomo, Makoto; Kodama, Kazunobu (Nagoya Inst. of Tech., Japan). Jap. Anal.; 20: No. 12, 1581-3(Dec 1971). (In Japanese).

Eriochrome Cyanine R reacts with uranium(VI) in a slightly acidic medium in the presence of cetyltrimethylammonium bromide to form a blue complex, which has its absorption maximum at about 610 nm. Maximum color development is obtained in the pH range from 5.3 to 5.9. The sensitivity is very high, the molar absorptivity being about 9×10^4 at 605 nm. Many of interfering cations can be masked by addition of a mixture of calcium(II) and cyclohexanediaminetetraacetic acid. The results obtained by the continuous variation method, which is carried out in the presence of excessive cetyltrimethylammonium bromide, indicate that a 1 : 2 (metal : ligand) complex is formed between uranium(VI) and Eriochrome Cyanine R. (auth)

14748 SIMPLE POLAROGRAPHIC METHOD FOR ANALYSIS OF URANIUM IN ORES. Taki, Minoru; Fujiwara, Shizuo (Tokyo Univ.). Jap. Anal.; 20: No. 12, 1583-5(Dec 1971). (In Japanese).

A simple polarographic method for analysis of uranium in ores was presented using potential buffer reagent. Ores of Ningyo Pass were employed as a sample. Uranium was extracted by 6N sulfuric acid aqueous media from the ores which powdered in below 100 mesh-size. Aluminum and iron ions were removed by adding sodium carbonate. Solutions for polarographic measurements were prepared directly from this filtrate: using a potential buffer solution which was made up of Menzel buffer reagent and sodium sulfate, well-defined polarographic waves were obtained. Uranium content in the fine particle part of the powder sample was found to be 1.45%. This procedure may be proposed as a simple and rapid method for the determination of uranium content in ores. (auth)

14749 SMALL AMOUNTS OF Mo AND Zn IN THE BAYER CYCLE. Papp, E.; Lovasi, J.; Tomcsanyi, L.; Zsindely, S. Femip. Kut. Intez. Kozlem.; No. 10, 217-28(1971). (In Hungarian).

A method was developed for the determination of Mo and Zn present in by-products of the Bayer process and in bauxites. The distribution of Mo and Zn in the Bayer cycle was investigated. The greater proportion of Mo was found to remain in the cycle, that which is entrained by alumina departing during calcination on account of the volatility of molybdenum oxide. Contrarily, the greater lot of Zn enters the red mud while the smaller (about one-third) contaminates alumina. Therefore, when processing bauxite with high Zn content, alumina produced in the Bayer process is found to contain Zn. (Hung. Tech. Abstr.)

14750 SPECTROPHOTOMETRIC DETERMINATION OF LANTHANIDES USING 4-(2-PYRIDYLAZO)RESORCINOL. Munshi, Kailash N.; Dey, Arun K. (Univ. of Nagpur, India. Univ. of Allahabad, India). Mikrochim. Acta; No. 5, 751-6(1971).

The formation of red color produced by the interaction of 4-(2-pyridylazo)resorcinol (PAR) and rare earths was studied to determine the composition, stability, and other characteristics of the chelates formed. The λ_{max} of all the chelates was found to be 515 nm at p_H 6.2 whereas the λ_{max} of the PAR reagent at this p_H is 410 nm. The composition of the chelates was found to be 1 : 2 (metal : PAR) and was established by two different methods. Stability constant values were calculated by three different methods. The values of log K, lies in the range of 9.2 to 10.4 for different rare earth chelates. The chelates are stable over a wide range of p_H. A tentative suggestion was also made for the position of the chelate ring. (auth)

14751 DEVELOPMENT AND APPLICATION OF COULOTRIMETRY: CONTROLLED-CURRENT COULOMETRIC TITRIMETRY. McCracken, Jack Edwin. Columbia, Mo.; Univ. of Missouri (1971). 173p. University Microfilms Order No. 71-30,671. Thesis.

A coulometric titrator was designed and constructed, which controls the titrating current in a novel manner during a controlled-current coulometric titration. In a typical titration the current is small in regions of rapid potential change and large in regions of slow potential change. A zero-current potentiometric indicator system was used. The titrator was designed to titrate substances in quantities from 1 to 100 μeq. At the 100 μeq level, the integrator readout potential can be read to ±200 ppM. Titration cells were designed for use in the four major areas of coulometric titrimetry: reduction-oxidation, acid-base, precipitation and complexometric determinations. Uranium was determined with a precision and accuracy of ±0.04% at the 2 mg level and ±8% at the 5 μg level by oxidation of U(IV) at 25°C. Mixtures of iron and uranium were determined with a precision and accuracy of ±0.02% (for 1 mg of iron) and ±0.04% (for 4.7 mg of uranium). Vanadium was determined by oxidation of V(II) to V(V) and mixtures of vanadium, uranium, and iron were determined in a single titration. In a sample that contained 1 mg iron, 1.1 mg vanadium, and 2.3 mg of uranium, the accuracy and precision for the determination of each metal was less than ±1%. Chloride, bromide, and iodide ions were titrated individually and in mixtures by Ag(I) precipitation. The precision and accuracy for the halide determinations was ca ± 0.1% (25 μmole amounts) when titrated individually. When mixtures of the three halides were determined in a single titration, the accuracy and precision was ±1.4% for chloride, ±0.7% for bromide, and ±0.5% for iodide. The amount of each halide present in the mixture determination was 2.5 μmoles. Complexometric determinations were made of Nd(III) and Cm(III) samples. Determinations of curium-248 resulted in the determination of the specific activity

of curium-248. Preliminary studies are reported which concern the determination of the oxygen-to-metal ratio in plutonium–uranium fuels. Other determinations which were done include the oxidation of Ce(III), the oxidation of Pu(III) to Pu(VI), and the oxidation of iodide ion. (Diss. Abstr. Int. B)

14752 USE OF THE METHOD OF THIN LAYER CHROMATOGRAPHY FOR THE IDENTIFICATION AND SEPARATION OF RHENIUM AND ACCOMPANYING ELEMENTS IN SOLUTIONS OF ALKALIES. Gaibakyan, D. S.; Babayan, Kh. S. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 1, 11-13(Jan 1971).

Translated from Zavod. Lab.; 37: No. 1, 9-11(Jan 1971).

Thin layer chromatography was used to identify and determine microgram quantities of rhenium(VII) in alkaline medium in the presence of Mo(VI), V(V), and W(VI). Solutions of sodium and ammonium hydroxides or their carbonates were used as the initial solutions in the separation. Addition of ethanol or methanol to NaOH solutions eliminated tails on chromatograms. Complete separation of the ions is possible at a 1:1 volume ratio of alcohol to 3N NaOH. Results of the determination of rhenium in a molybdenum concentrate were found to compare favorably with the thiocyanate method. The detectable minimum is 0.05 $\mu g/\mu l$. (J.G.B.)

14753 POLAROGRAPHIC DETERMINATION OF LEAD USING COPRECIPITATION WITH THORIUM HYDROXIDE. Ueda, Shunzo; Fujihara, Kikuo; Miyakawa, Hiroo; Yamamoto, Yoshikazu (Kanazawa Univ., Japan). Nippon Kagaku Zasshi; 92: No. 11, 979-82(Nov 1971). (In Japanese).

Collection of trace amounts of lead by coprecipitation with thorium hydroxide and polarographic determination of the lead were studied. Lead was coprecipitated quantitatively with thorium and its polarogram was not affected by the presence of the coprecipitant. The following procedure was established: To a sample solution (50 to 2000 ml) containing 20 to 500 μg of lead, 2.5 ml of thorium nitrate solution (10 mg Th/ml) and ammonium chloride are added. This solution is adjusted to pH 10.5 with ammonium hydroxide and heated to 60°C. Then it is set aside for an hour. The precipitate is dissolved in 12.5 ml of concentrated hydrochloric acid and 0.5 ml of 0.05% gelatin solution is added. After the whole is diluted to 25 ml, lead is determined polarographically. The error was within 5%. There was no interference from 10 mg each of 19 diverse ions such as aluminum, manganese(II), nickel, zinc, arsenic(V), etc. Trace amounts of lead in copper could be determined by this method. (auth)

14754 DICHROMETRIC TITRATION OF URANIUM(IV) USING DIPHENYLAMINE, DIPHENYLBENZIDINE, OR BARIUM DIPHENYLAMINE SULPHONATE AS INDICATORS. Dutt, V. V. S. Eswara; Rao, N. Venkateswara (Andhra Univ., Waltair, India). Z. Anal. Chem.; 256: No. 5, 357-8(1971).

It was found that, for the dichrometric titration of uranium sulfate solution using diphenylamine, diphenylbenzidine, and barium diphenylamine sulfonate, a medium of 4 to 8N sulfuric acid is highly suitable. The titration is not, however, possible in hydrochloric, phosphoric, or perchloric acid media. (M.C.G.)

14755 AMPEROMETRIC TITRATION OF METAL IONS WITH EDTA USING AN OXIDE ELECTRODE AS INDICATOR. THE LEAD(IV) OXIDE ELECTRODE, MANGANESE(IV) OXIDE ELECTRODE, AND BISMUTH(V) OXIDE ELECTRODE. Kainz, Gerald; Mueller, Hermann A.; Sontag, Gerhard (Univ., Vienna). Z. Anal. Chem.; 256: No. 5, 345-8(1971). (In German).

An apparatus was developed that indicates the endpoint of chelatometric titrations amperometrically. The most important part of this apparatus is a platinum anode, which is coated with a thin film of metal oxide. The cathode is bright platinum. A voltage (between 1.0 to 1.2) is applied to the electrodes. If after the equivalence point an excess of EDTA appears, the current between the electrodes rises abruptly. The following metal oxides are suitable: PbO_2, MnO_2, Bi_2O_5, and PtO_x. The conditions for the application of these oxide anodes were investigated. The current, caused by an excess of EDTA, depends on the pH of the solution. The electrodes can be employed between pH 1 and 3 and are suitable for titration of tervalent and tetravalent metal ions. The oxide electrodes, described in this paper, complete the oxide electrodes described formerly (Tl_2O_3, Co_2O_3, Ni_2O_3). The latter electrodes are applicable between pH 3 and 10. (auth)

14756 MICRODETERMINATION OF HALOGEN WITH SILVER BOAT. Honma, Haruo; Yoshida, Mutsuko; Suzuki, Keiko; Emoto, Sakae (Inst. of Physical and Chemical Research, Saitama, Japan). Jap. Anal.; 20: No. 8, 1042-4(Aug 1971). (In Japanese).

The microdetermination of halogen (except fluorine) in organic compounds was carried out by a micro–Carius method using a silver boat in place of silver nitrate. Chlorine and bromine in standard samples were determined satisfactorily but lower results were obtained for iodine. The result was affected by the amount of silver and the excess of silver caused the negative error. Good results were obtained by using about 40 mg of silver boat. The weighing is easier than in the ordinary method and the errors in weighing magnetized or adhesive samples may be minimized. (auth)

14757 DETERMINATION OF LIGHT ELEMENTS IN CLAYS, SOILS, AND MINERALS BY THE RADIOISOTOPIC X-RAY FLUORESCENCE METHOD. Vander, I. Z.; Gerling, V. E.; Smirnov, V. N. (Agrophysical Scientific-Research Inst., Leningrad). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 2, 203-7(Feb 1971).

Translated from Zavod. Lab.; 37: No. 2, 162-6(Feb 1971).

The comparative efficiency of radioisotopic sources in the analysis of the light elements with atomic number Z from 11(Na) to 20(Ca) was investigated. The x-ray emitters, $^3H/Ti$ and $^3H/Zr$ (with tritium activities of 2 and 30, Ci respectively); a monochromatic ^{55}Fe emitter (30 mCi) with a photon energy of 5.9 keV; and an α-emitter ^{238}Pu with an activity of 5.5 mCi were used as the sources. The intense emission of the uranium L-series ($E_{L\alpha}$= 13.6, $E_{L\beta}$= 17.2 keV, total yield 13%) was observed in the spectrum of ^{238}Pu. Methods for determining iron, calcium, potassium, aluminum, magnesium, and silicon are described. (D.H.M.)

14758 MASS SPECTROMETRIC DETERMINATION OF BURN-UP. Komori, Takuji; Tamura, Shuzo; Yoshida, Hiroyuki; Gunji, Katsubumi; Tamura, Kimiko (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 13: No. 12, 688-93 (Dec 1971). (In Japanese).

The mass spectrometric technique was applied to determination of burnup of an irradiated fuel of JRR-1 (20% ^{235}U, uranyl sulfate solution). Three different methods were used, based respectively on uranium isotopic ratio, and on the measurement of stable fission product neodymium and molybdenum. The isotopic ratios were measured with a surface-ionization-type mass spectrometer. The uranium isotopic ratio method consists of the measurement of isotopic change of uranium before and after irradiation. In the neodymium and molybdenum methods, uranium and fission product neodymium and molybdenum were determined by isotope dilution-mass spectrometry using natural uranium, ^{150}Nd, and ^{96}Mo, respectively, as spikes. The burnup was calculated from the ratios of concentration referred to uranium presented by neodymium and molybdenum. While chemical separation is essential prior to mass spectrometry, quantitative recovery of these three elements is not necessary. The results obtained by three methods are in good agreement, and the neodymium method was found to be best in sensitivity, precision, and accuracy. (auth)

14759 EXTRACTION-PHOTOMETRIC DETERMINATION OF A TRACE IMPURITY OF TITANIUM IN NIOBIUM AND TANTALUM. Nazarenko, V. A.; Shustova, M. B. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 2, 181-2(Feb 1971).

Translated from Zavod. Lab.; 37: No. 2, 146-7(Feb 1971).

An attempt was made to increase the selectivity of the extraction of titanium by acid alkyl phosphate esters, using various complexants to mask niobium and tantalum. The experiments indicated that trace amounts of titanium are practically quantitatively extracted from 10% oxalic acid by a mixture of isoamyl phosphoric esters, while the extraction of niobium and tantalum is almost entirely suppressed: no more than 100 μg passes into the extract from 0.5 g of niobium or tantalum. The complete separation of niobium and tantalum necessitates repeated extraction, which is performed after titanium is transferred to the aqueous phase. The extraction of titanium from a mixture of acid isoamyl phosphoric esters is difficult, but after the addition of tributyl phosphates, it can be performed quantitatively with a hydrochloric acid solution of hydrogen peroxide. The method was used to determine an impurity of titanium in niobium and tantalum pentachlorides. The standard deviation was S = 0.0595. (D.H.M.)

14760 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM WITH TICHROMIN IN ALLOYS BASED ON VANADIUM AND TUNGSTEN. Basargin, N. N.; Yakovlev, P. Ya.; Panarina, N. A.; Onuchina, G. V. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 2, 178-80(Feb 1971).

Translated from Zavod. Lab.; 37: No. 2, 143-6(Feb 1971).

The possibility of using the uncolored reagents tichromin [N-methyl-N, N-bis(methylenechromotropic acid)amine] and tipyrogin [N-methyl-N, N-bis(methylenepyrogallol)amine], which form colored complexes with niobium in mineral acid media, as the reagents for the photometric determination of niobium was explored. The optimum acidity of the medium for the formation of a complex with tipyrogin is 0.25 to 0.5 N HCl. The reagents and its complex with niobium are precipitated in sulfuric acid medium. With tichromin niobium forms a complex with maximum optical

density in the medium 0.1 to 6 N HCl or 0.5 to 7 N H_2SO_4. A method is presented for the determination of niobium in V–Nb and V–W–Nb alloys (up to 10% W) using tichromin. (D.H.M.)

14761 SOME PECULIARITIES AND CONDITIONS IN THE USE OF RADIOISOTOPIC GAMMA RADIATION SOURCES FOR X-RAY RADIOMETRIC ORE ASSAYING. Leman, E. P.; Ochkur, A. P.; Bolotova, N. G.; Yanshevskii, Yu. P.; Mitov, V. N. Vop. Razved. Geofiz.; No. 11, 12-18(1969). (In Russian).

In order to optimize the use of the x radiometric method for ore assay, it is necessary to choose the best γ source and the best geometry of measurement. The theory associated with these criteria is developed. The problems of choosing a radiation source that will assure sufficient excitation of the analytical lines of the element being determined are exemplified in a comparison of ^{35}S, ^{170}Tm, ^{181}W, ^{204}Tl, and ^{57}Co in their ability to produce the K_α radiation of tin. Use of a wide solid angle without collimation and γ radiation < 60 keV is where $Z \geq 50$ to 55. Collimated radiation from a source >60 keV is better where $Z \geq 50$ to 55. (K.S.W.)

14762 INVESTIGATION OF CONDITIONS FOR THE PHOTOMETRIC DETERMINATION OF TANTALUM IN STEELS WITH THE REAGENT PAR. Elinson, S. V.; Pobedina, L. I.; Rezova, A. T. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 5, 661-3 (May 1971).

Translated from Zavod. Lab., 37: No. 5, 521-4(May 1971).

In connection with the determination of Ta in steels and alloys, the properties of the complex formed between Ta and the resorcinol derivative PAR (pyridylazoresorcinol) were studied. The strongest and most sensitive complex was formed in the presence of citrate ions at pH 5.4. The molar extinction coefficient of the complex at 540 nm was 2.5×10^4, the maximum absorption occurring at 560 nm. Using this complex, the Ta content of a number of steels was determined with an error of 0.2%. The effects of Fe, Co, Ni, Cr, Ti, Mo, and W are easily masked. (Metals Abstr.)

14763 DETERMINATION OF FREE ACID IN AQUEOUS SOLUTIONS OF URANIUM(IV) NITRATE AND PERCHLORATE. Schmid, E. R.; Juenger, E. (Univ., Vienna). Z. Anal. Chem.; 257: No. 2, 112-16(1971). (In German).

Methods described in the literature for the determination of free acid in solutions containing plutonium(IV), uranium(VI), and aluminum(III) were investigated for their applicability in the presence of uranium(IV). Most methods work in the presence of uranium(IV). The simplest procedure was the suppression of the uranium(IV) hydrolysis by complexation with excess of fluoride. No bias was observed in the presence of 0 to 30 mg of uranium (IV). A variance of 1.4% resulted from the determination of 0.4 millimole of acid in the presence of 26 mg of uranium(IV) and a variance of 0.26% was obtained when 2 millimoles of acid were determined in the presence of 130 mg of uranium(IV). Uranium(IV) from 30 to 260 mg in 250 ml caused a negative bias, which can be corrected. A concentration of potassium fluoride in the titration medium of 10 g/l turned out to be optimum. In 1½ years more than 750 determinations were carried out with the same glass electrode and no destruction of the electrode was observed. The influence of uranium(VI), iron(III), and aluminum(III) on the determination of the free acid was also investigated. (auth)

14764 TRANSITION METAL CHALCOGEN COMPOUNDS: PHOTOMETRIC DETERMINATION OF MOLYBDENUM USING THE MoS_4^{2-}-ION. Diemann, E.; Mueller, A. (Univ., Dortmund, Ger.). Z. Anal. Chem.; 257: No. 2, 116-18(1971). (In German).

During the reaction of tetraoxomolybdate(VI) with hydrogen sulfide the ion MoS_4^{2-} is formed, which shows strong absorption bands in the visible and uv region. A band at 463 nm ($\epsilon \approx 1.3 \times 10^4$) is used for the photometric determination of molybdenum. A procedure is reported and its applicability is discussed. The standard deviation was ±2% (0.5 mg of Mo). (auth)

14765 NEW METHOD FOR THE COMPLEXOMETRIC DETERMINATION OF RUBIDIUM AND CESIUM. Boguslawska, K.; Cyganski, A. (Institut fuer Allgemeine Chemie, Lodz, Poland). Z. Anal. Chem.; 257: No. 2, 132-3(1971). (In German).

The precipitation of cesium or rubidium as $M_2Sr[Cu(NO_2)_6]$, where M is Rb or Cs, forms the basis of the method described. Results showed that the complexometric method is better than the gravimetric method. (M.C.G.)

14766 ESTIMATION OF MOLYBDENUM IN STEELS. Ramani, A. V.; Sreepathy, S.; Rajagopalan, S. R. (National Aeronautical Lab., Bangalore, India). Curr. Sci. (India); 41: No. 2, 58-9(20 Jan 1972).

The cause of irreproducibility in the spectrophotometric determination of molybdenum based on the colored thiocyanate complex was investigated. It was linked with absorbance of the blank affected by nitric acid. (M.C.G.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 15208, 15242, 15272, 15289, 15290, 15524, 15526, 15804, 15855, and 16792.

14767 (CEA-CONF-1887) MEASUREMENT OF THE COMPOSITION OF FUEL MATERIALS BY NONDESTRUCTIVE METHODS. Guery, M.; Robin, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1971]. 11p. (In French). (CONF-710940–1). Dep. NTIS (U. S. Sales Only).

From International meeting on nondestructive measurement and identification techniques in nuclear safeguards; Ispra, Italy (20 Sep 1971).

Several methods of analyzing fissile fuels are presented. The α spectrometry of thick sources is an original method limited to nonirradiated fuels. The three other methods (measurement of neutron emission, γ spectrometry, and measurement of the variations in the capture rate and in the neutron production) are more classic; they are very suitable for measurements on the composition of irradiated fuels. (France)

14768 (CONF-680423–, pp 140-4) METHODS FOR THE MEASUREMENT OF TRITIUM BY MEANS OF LIQUID SCINTILLATORS. Carrasco, J. Lezama (Comision Nazional de Energia Nuclear, Mexico City). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

Three methods using liquid scintillators (measurement using a photomultiplier tube, integral method, and coincidence method) were studied. The coincidence method was the most satisfactory since its efficiency of counting with respect to the background, to variations of temperature, and to the effects of photoluminescence were good. The high sensitivity of the device makes it useful in cases in which it is necessary to measure tritiated compounds of very low specific activity. Its simple operation permitted great rapidity in the measurement. (tr-auth)

14769 SOME SIMPLE METHODS FOR DETERMINATION OF ^{137}Cs IN SEA WATER. Bauman, Alica (Inst. for Medical Research and Occupational Health, Zagreb). Arh. Hig. Rada Toksikol.; 21: No. 4, 321-6(1970). (In Serbo-Croatian).

Cesium-137 can easily be recovered from seawater by a batch method based on treatment with ammonium phosphomolybdate. The method was conveniently applied for the separation of ^{137}Cs in the Adriatic. Another method for rapid separation of ^{137}Cs from seawater by precipitation with sodium triphenylcyanoborate is described. The chemical yield was obtained by weighing the precipitate. Gamma spectra of all samples were measured on a 206-channel analyzer with a NaI/Tl 4 × 4″ crystal. (auth)

14770 CHOICE OF DURATION OF GAMMA-SPECTRAL ASSAYING OF URANIUM–THORIUM ORES. Sinitsyn, A. Ya. Zap. Leningrad. Gorn. Inst.; 56: No. 2, 107-12(1969). (In Russian).

On the basis of an analysis of the statistical error of counting rate in individual points and areas of the curves obtained in logging uranium and thorium ores, and also of the error in determining U and Th content in ore layers, it is proposed that in interpreting gamma-spectral data, the areas of the logs be used together with counting rates. This shortens the duration of measurements at individual points several times, practically without sacrificing accuracy in determining the U and Th content of ore. (Geophys. Abstr.)

14771 NEUTRON MEASURING METHOD OF CHLORINE CONTENT IN AQUEOUS SOLUTIONS. Machaj, Bronislaw; Paryski, Zygmunt (Instytut Badan Jadrowych, Warsaw). Nukleonika; 16: No. 5-6, 251-7(1971). (In Polish).

A neutron method of measuring the chlorine content in aqueous solutions is presented. The results of experimental measurements allow one to expect the accuracy of determination to be 0.2% when the chlorine concentration in the solution lies in the range up to 10%. (auth)

14772 LINC-8 PROGRAM THAT COMPUTES ACTIVITIES OF DOUBLY LABELED, VARIABLY QUENCHED LIQUID SCINTILLATION SAMPLES. Forker, E. L.; Wycoff, Delane (Univ. of Iowa, Iowa City). Anal. Biochem.; 45: No. 1, 107-11(Jan 1972).

The need to measure two isotopes simultaneously in a large number of variably quenched samples led to development of a computer program for converting raw data from a three-channel liquid scintillation counter to disintegrations per minute for each isotope. The program is written for a small computer (LINC-8). An outline of the program is presented. (M.C.G.)

14773 NONDESTRUCTIVE ANALYSIS FOR TRACE AMOUNTS OF HYDROGEN. Cohen, B. L.; Fink, C. L.; Degnan, J. H. (Univ. of Pittsburgh). J. Appl. Phys.; 43: No. 1, 19-25(Jan 1971).

A method is described and demonstrated for a nondestructive determination of the hydrogen content inside materials in sheet form by measurement of the energy-loss distribution from proton-proton scattering events. The method is absolutely specific for hydrogen, and has a sensitivity of 1 ppM (atomic), or better. Materials analyzed (with ppM of hydrogen in parentheses) were: Ti (4200), Zr (5000), Al (20), Fe (~10), C (13000), and Teflon (220). In the titanium and zirconium samples, the hydrogen content drops off near the surfaces. The method also detects oil or moisture on surfaces for thicknesses down to about 1 Å; all materials studied had such surface films several hundred Å thick. (auth)

14774 COMPARISON OF SCINTILLANTS FOR DETERMINATION OF RADIOACTIVITY IN AGAR GEL BY LIQUID SCINTILLATION TECHNIQUES. Naqvi, S. M. (Atomic Energy Commission, Roskilde, Denmark). Nucleus (Karachi); 8: No. 3, 109-12(Jul-Sep 1971).

Comparison between ethanol–toluene and Triton X-100–toluene (1:3) scintillant was made for the liquid scintillation counting of ^{14}C-1AA (indoleacetic acid) in aqueous solutions incorporated into 1.5% agar and in tissue sections. It was observed that 15 ml of ethanol scintillant was comparatively better than Triton scintillant in counting efficiency and simplicity. (auth)

14775 CHOICE OF THE PARAMETER CHARACTERIZING THE CHEMICAL COMPOSITION OF A ROCK IN THE GAMMA–GAMMA SELECTIVE METHOD. Charbucinski, Jacek; Gyurcsak, Jan (Inst. of Nuclear Techniques, Krakow). Nukleonika; 16: No. 5-6, 259-69(1971). (In Polish).

A discussion is presented of the applicability of the equivalent atomic number as a parameter which characterizes the chemical composition of rocks in the gamma-gamma selective method. It has been shown that the use of the equivalent atomic number for the case of ores leads to ambiguous results. A new parameter (the equivalent concentration of a heavy element) has been proposed, and its usefulness has been checked experimentally for Zn, Pb, Ba, and Mo ores. (auth)

14776 SCINTILLATION COUNTING OF AQUEOUS SOLUTIONS OF ^{3}H RNA. Hellung-Larsen, Per (Biokemisk Institut, Copenhagen). Acta Chem. Scand.; 25: No. 4, 1359-69(1971).

The radioactivity in various aqueous solutions of ^{3}H RNA was recorded in nine known and two new scintillation liquids by 1. direct addition to the scintillation liquids; 2. prior treatment with solubilizer; and 3. prior plating on filters. By proper combination of method and scintillation liquid, stable high-efficiency measurements could be obtained. (auth)

14777 ABSOLUTE METHOD OF MEASUREMENT OF ^{14}C ACTIVITY BY 4π LIQUID SCINTILLATION COUNTER. Radoszewski, T. (Inst. of Nuclear Research, Warsaw). pp 15-22 of Liquid Scintillation Counting. Vol. 1. Dyer, A. (ed). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The results of measurements of n-hexadecane labeled with ^{14}C are given; counting was done in singles, in coincidence, and in parallel. The equipment and method are described, and the counting efficiency for the various systems is tabulated. Secondary pulses arising at the scintillation counter after the main pulses are discussed. (6 figures, 2 tables) (R.W.R.)

Separation Procedures

Refer also to abstracts 15013, 15015, and 15016.

14778 CHROMATOGRAPHIC SEPARATION OF LANTHANIDES ON A CIRCULAR FILTER PAPER IMPREGNATED WITH OXINE AS THE IMMOBLE PHASE. Nagai, Hideo (Kumamoto Univ., Japan); Kiyoshima, Hiroo. Jap. Anal.; 20: No. 10, 1289-92(Oct 1971). (In Japanese).

Separation of lanthanides by reversed phase chromatography was carried out on an oxine-impregnated filter paper on the condition that lanthanide ions might be partitioned between the two liquid phases that appeared when an aqueous acetic acid solution was added with phenol and oxine. The following sample solutions were effectively separated; binary mixtures of La–Ce, Pr–Nd, Nd–Sm, Sm–Eu, Eu–Gd, Gd–Tb, Tb–Dy, Dy–Ho, Ho–Er, Er–Tm, Tm–Yb, Yb–Lu, Ce–Nd, Ce–Sm, Ce–Eu, Ce–Gd, Ce–Tb, Ce–Dy, Ce–Ho, Ce–Er, Ce–Tm, Ce–Yb, Ce–Lu, La–Pr, La–Nd, La–Sm, La–Eu, La–Gd, La–Tb, La–Dy, La–Ho, La–Er, La–Tm, La–Yb, La–Lu, Nd–Eu, Nd–Gd, Nd–Tb, Nd–Dy, Nd–Ho, Nd–Er, Nd–Tm, Nd–Yb, and Nd–Lu, ternary mixtures of Nd–Gd–Ho and La–Dy–Tm, a quaternary mixture of La–Nd–Gd–Ho, and a quinquenary mixture of La–Ce–Nd–Gd–Ho. In all cases the separation of Ce–Pr was not clearcut. The most widely applicable developing solvent was made as follows: 100 ml of 1% acetic acid solution saturated with phenol at 25°C was added with 2g oxine and allowed to stand till the liquid phase separated into two layers, the upper layer of the solvent was used as the developer. In this case the filter paper treatment was carried out as follows: 100 sheets of 11-cm circular filter paper were immersed in the solution of 145 ml ethanol (95%) in which 1.0 g oxine was dissolved, then dried in an air bath at ca 90°C. Developing was done as routine circular paper chromatography by inserting a narrow strip of untreated filter paper in a slit cut at the center of the oxine-impregnated filter paper. The developing was continued till the solvent front reached a 3 cm distance from the center of the filter paper. The chromatogram thus obtained was cut into two pieces, and the detection of the ionic bands was carried out. One of the semicircular chromatograms was exposed in ammonia vapor, then the ionic bands colored in yellowish concentric semicircles. The other piece of chromatogram was sprayed with 0.2% aqueous solution of Arsenazo III, then the ionic bands colored in greenish concentric semicircles. (auth)

14779 SYNERGIC SOLVENT EXTRACTION OF RARE EARTHS. II. THE ABSORPTION SPECTRA OF NEODYMIUM-, HOLMIUM-, AND ERBIUM-TTA-TOPO COMPLEXES WITH ClO_4^-, CNS^-, NO_3^-, AND Cl^- IONS. Taketatsu, Tomitsugu; Ohkura, Nobuyo (Kyushu Univ., Fukuoka). Bull. Chem. Soc. Jap.; 44: No. 9, 2430-3(Sep 1971).

The synergic solvent extraction behavior of neodymium, holmium, and erbium in Ln^{3+}–X^-–HTTA–TOPO systems (X^- = ClO_4^-, CNS^-, NO_3^-, and Cl^-) was investigated. When the rare earths are completely extracted into an organic layer, the following equation is assumed: $Ln(TTA)_3(TOPO)_{2(o)} + 3TOPO_{(o)} + H^+_{(a)} + X^-_{(a)} \rightleftharpoons (Ln(TTA)_3(TOPO)_5)^+X^-_{(o)} + HTTA_{(o)}$, for which the mixed equilibrium constant is defined by $k_3 = [(Ln(TTA)_2(TOPO)_5)^+X^-]_{(o)}[HTTA]_{(o)}/[Ln(TTA)_3(TOPO)_2]_{(o)}[TOPO]^3_{(o)}[H^+]_{(a)}[X^-]_{(a)}$. The log k_3 value for the holmium–ClO_4^-–CNS^-–NO_3^-, and –Cl^- systems is about 8.3, 6.5, 5.3, and 3.6, respectively. An obvious difference between Ln^{3+}–SO_4^{2-}–HTTA–TOPO and Ln^{3+}–ClO_4–HTTA–TOPO systems was observed in the order of the distribution ratio on the extraction of a series of rare earths with an increase in the atomic number. (auth)

14780 SEPARATION OF RARE EARTH ELEMENTS BY ION EXCHANGE. Winget, J. Oscar; Lindstrom, Roald E. (to Secretary of the Interior). U. S. Patent 3,615,173. 26 Oct 1971. Filed 3 Apr 1969.

Diethylenetriaminepentaacetic acid or hydroxyethylethylenediaminetriacetic acid is used as retaining agent in separating rare earth elements on a cation-exchange resin column. (auth)

14781 PROCESS FOR SEPARATING METALS USING DOUBLE SOLVENT EXTRACTION WITH BRIDGING SOLVENT MEDIUM. Hazen, Wayne C.; Hadzeriga, Pablo; Kruesi, Paul R. (to Molybdenum Corp. of America). U. S. Patent 3,615,170. 26 Oct 1971. Filed 3 Dec 1969.

Solutions of metal values are fractionated by a double solvent liquid-liquid extraction process wherein the solution is contacted with one extractant to selectively remove at least one metal value, then the solution is contacted with a second extractant to selectively remove another metal value, and the solution depleted of both metal values is recycled in a bridge between the two extractions. The process permits separation in aqueous and nonaqueous media; and it improves separation efficiency by allowing equilibration of metal values between the unmixed extractants and by permitting countercurrent flows. The process is especially useful to fractionate rare earth metal values and yttrium. (auth)

14782 USE OF DIPHOSPHINE DIOXIDES AS EXTRACTANTS IN LIQUID–LIQUID EXTRACTION FROM FUSED ALKALI NITRATES. Mesplede, J.; Porthault, M. (Faculte des Sciences, Lyon). J. Inorg. Nucl. Chem.; 33: No. 12, 4275-82(Dec 1971). (In French).

The extraction of Co(II), Pr(III), Eu(III) and Tm(III) from molten alkali nitrates at 160°C by diphosphines dioxides as $[(C_6H_5)_2P(O)]_2-(CH_2)_n$ with n = 2, 3, 4, 6 was studied. Extracted complexes and equilibrium extraction constants are given. (auth)

14783 EXTRACTION OF ZIRCONIUM USING DIANTIPYRYLPROPYLMETHANE. Rudenko, N. P.; Naier, R. G. Sov. Radiochem. (Engl. Transl.); 13: No. 2, 296-8(Mar-Apr 1971).

Translated from Radiokhimiya; 13: No. 2, 291-3(Mar-Apr 1971).

The extraction of zirconium from hydrochloric acid solutions with chloroform solutions of diantipyrylpropylmethane (DP) as a function of the DP and HCl concentrations was studied. The degree of extraction of Zr increases with increasing concentration

of doubly protonated DP. It was hypothesized that Zr is extracted in the form of an ionic associate, the cation of which is doubly charged diantipyrylpropylmethanium, while Zr is included in the complex anion (chloride). (auth)

14784 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF REACTIONS OF EXTRACTION OF URANYL NITRATES BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. III. TRI-n-PROPYL PHOSPHATE (TPP). Shpunt, L. V.; Komarov, E. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 485-8(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 463-6(May-Jun 1971).

The structure of the complex $UO_2(NO_3)_2 \cdot 2TPP$ (where TPP is tripropyl phosphate) was established. The distribution coefficients of TPP between aqueous solutions and carbon tetrachloride and n-decane were found at 10 to 50°C and TPP concentration in the organic phase of 0.08 to 0.15 M. The thermodynamic equilibrium constants of the extraction of uranyl nitrate by solutions of TPP in carbon tetrachloride and n-decane were determined at 10 to 50°C. The thermodynamic functions of the extraction reaction ΔH (cal/mole), ΔG (cal/mole), and ΔS (cal/deg · mole) at t = 25°C were determined according to the temperature dependence of the constant. (auth)

14785 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF REACTIONS OF EXTRACTION OF URANYL NITRATE BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. II. TRIETHYL PHOSPHATE (TEP). Shpunt, L. B.; Komarov, E. V.; Pushlenkov, M. F. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 482-4(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 461-3(May-Jun 1971).

The thermodynamic constants of the equilibrium of the extraction of uranyl nitrate with solutions of TEP (triethyl phosphate) in carbon tetrachloride at 10 to 50°C were determined. The values of ΔH, ΔG, and ΔS of the extraction reaction were found at t = 25°C. (auth)

14786 EXTRACTION OF COMPLEX ACIDS BY OXYGEN-CONTAINING SOLVENTS. XIX. INFLUENCE OF TEMPERATURE ON THE JOINT EXTRACTION OF COMPLEX ACIDS. Iofa, B. Z.; Abramov, A. A.; Kropotov, V. A. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 489-91(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 466-8(May-Jun 1971).

The influence of temperature on the joint extraction of tellurium(IV) and indium(III) from 2M HCl with methyl butyl ketone was studied. Distribution coefficients were calculated. (M.C.G.)

14787 ANALYTICAL METHOD OF GROUP SEPARATION OF A MIXTURE OF FISSION PRODUCTS IN THE PRESENCE OF CARRIERS ON CATION EXCHANGE RESINS. Vdovenko, V. M.; Krivokhatskii, A. S.; Skovorodkin, N. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 432-6(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 416-21(May-Jun 1971).

A method of group separation of radioisotopes in the presence of weighable amounts of isotopic carriers and certain typical impurities is described. The method is based on the use of the cation exchange resin Dowex-50X8 with the aid of various eluents. The fission products investigated could be separated into 6 fractions: 1) Ru, Mo, Zr, Nb, Sb (and possibly, Gd and Pd); 2) Cs, Rb (partially Sb); 3) Sr, Ba; 4) Zr; 5) transplutonium elements and partially rare earth elements heavier than Gd and Y; and 6) rare earth elements. (M.C.G.)

14788 INVESTIGATION OF THE INFLUENCE OF THE STRUCTURE OF TRIALKYLAMINE NITRATES ON THE EXTRACTION SEPARATION OF AMERICIUM AND CURIUM. Chudinov, E. G.; Pirozhkov, S. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 411-15(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 396-401(May-Jun 1971).

Regression equations describing the change in the distribution coefficient of Am(III) and Cm(III) as a function of the concentration of trialkylammonium nitrates, lithium nitrate, and nitric acid, were obtained by statistical methods of experimental planning. These equations were obtained for trioctylamine and three amines of the type of CH_3R_2N (where R is alkyl with a number of carbon atoms n_c = 8, n_c = 10 to 12, and n_c = 15 to 18). The mechanism of extraction and separation depends on the structure of the extraction reagent molecule. (auth)

14789 APPLICATION OF A STATISTICAL METHOD TO THE INVESTIGATION OF THE RETENTION OF LANTHANUM ON CALCIUM FLUORIDE. Bourreilly, I. N.; Chayla, B. (Laboratoire d'Analyse par Activation Pierre SUE, Gif-sur-Yvette, France. CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 9: No. 1, 45-54(15 Jan 1972). (In French).

A Plackett–Burman arrangement was used for screening a number of variables affecting the retention of lanthanum on calcium fluoride. The effect of the crystal form of calcium fluoride was found to be most significant; the highest retention yields were obtained with precipitated calcium fluoride. (auth)

14790 SEPARATION OF TRACE ELEMENTS BY PRECIPITATION. IX. FURTHER STUDY OF THE SORPTION OF URANIUM(VI) IN CARBONATE MEDIA. Upor, E.; Nagy, Gy. (Mecsek Ore Mining Enterprise, Pecs, Hungary). Acta Chim. Acad. Sci. Hung.; 70: No. 3, 185-8(1971).

As a supplement to earlier work, a study was made of how the pH-dependence of the sorption of uranium(VI) on $Fe(OH)_3$ in carbonate media changes with the concentration of the carbonate. It was found that a low carbonate concentration (1×10^{-3} M), sorption is complete below pH = 11 and the curve is identical with that obtained in an NaOH medium. In the case of macro amounts of uranium, however, desorption above pH = 12 in carbonate solution does not occur. The slope of the log $[CO_3^{2-}]$ vs. log D_U straight line at different pH values is (1.0 ± 0.2); this necessitates the further clarification of the desorption mechanism. (auth)

14791 INFLUENCE OF TEMPERATURE ON THE EXTRACTION OF HAFNIUM SULFATES BY AMINES. Yagodin, G. A.; Chekmarev, A. M.; Vladimirova, L. M. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 465-6(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 448-9(May-Jun 1971).

Extraction was performed, using trioctylamine, in separatory funnels with a water jacket and the phases were stratified at the temperature of extraction. The nature of the influence of temperature on the extraction was determined by the acidity of the aqueous phase. An analogous nature of the dependence was also observed in the extraction of zirconium. The coefficients of separation of Zr–Hf depend weakly on the temperature under the conditions studied. (M.C.G.)

14792 THIN-LAYER CHROMATOGRAPHY OF ANIONS. Brezgunova, I. N.; Smolyaninov, V. V.; Kharlamova, N. I. (Protein Inst., Pushchino-on-Oka, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 7, 1012-13(Jul 1971).

Translated from Zh. Fiz. Khim.; 45: No. 7, 1785-6(Jul 1971).

A method is described which permits the separation of phosphates, sulfates, halides, and polithionates of organic and inorganic bases. R_f values of various anions, including I^-, are tabulated. (auth)

14793 SORPTION OF CALCIUM AND STRONTIUM IONS BY TITANIUM AND ZIRCONIUM HYDROXIDES. Deak, M.; Kiseleva, E. D.; Semenovskaya, T. D.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 7, 989-90(Jul 1971).

Translated from Zh. Fiz. Khim.; 45: No. 7, 1748-50(Jul 1971).

The use of buffer mixtures promotes an increase in the degree of dissociation of the exchanging groups of hydroxide sorbents and in their sorption capacity. At pH 11 the amounts of calcium sorbed on titanium and zirconium hydroxides are respectively 6.0 and 3.7 mequiv g^{-1} (t = 20°C). (auth)

14794 NEPTUNIUM EXTRACTION FROM ALKALINE SOLUTIONS. Novikov, Yu. P.; Myasoedov, B. F.; Ivanova, S. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 9: No. 2, 85-91(30 Jan 1972).

The extraction of neptunium from alkaline neptunium (VII) solutions with dibenzoylmethane (indexed as 1,3-diphenyl-1,3 propanedione) was studied as a function of the alkali concentration, time, nature of the solvent and the dibenzoylmethane and neptunium concentration. The extraction mechanism is connected with the reduction of neptunium to Np (VI). (auth)

14795 SYNTHESIS AND APPLICATIONS OF ANION EXCHANGERS BASED ON 4-METHYL-2-VINYLPYRIDINE. Zubakova, L. B.; Osokina, M. P.; Davankov, A. B.; Korshak, V. V. J. Appl. Chem. USSR (Engl. Transl.); 44: No. 7, 1580-3(Jul 1971).

Translated from Zh. Prikl. Khim.; 44: No. 7, 1562-5(Jul 1971).

Study of polymerization of 4-methyl-2-vinylpyridine in isopropyl alcohol showed that the yield and molecular weight of the polymer depend on the polymerization time. The weakly basic anion exchanger 4,2-MVP-3 of ordinary and macroporous structure was synthesized. It is a copolymer of 4-methyl-2-vinylpyridine and triethylene glycol dimethacrylate. Determinations of the sorption capacity of 4-methyl-2-vinylpyridine homopolymer for uranyl nitrate in solution showed that the homopolymer has the highest sorption capacity (82.5%) if taken in 7:1 molar ratio to the salt. The convex form of the isotherm for sorption of hydrochloric acid by 4,2-MVP-3 anion exchanger is evidence of an equilibrium course

of sorption. Suspension copolymerization of 4,2-MVP with TGM-3, yielding well-defined spherical granules, is simpler technologically than copolymerization of 2-methyl-5-vinylpyridine with the same diene. (auth)

14796 EXTRACTION OF PEROXIDE COMPLEXES OF NIOBIUM AND TANTALUM WITH DIBUTYLPHOSPHORIC ACID. Gorlach, V. F. (Kiev State Univ.). Zh. Anal. Khim.; 26: No. 12, 2372-5(Dec 1971). (In Russian).

The extraction of peroxide complexes of niobium and tantalum with a solution of dibutyl phosphate (DBPA) in benzene depending on the H_2SO_4 concentration in the aqueous phase was studied. It was found that niobium and tantalum are extracted into the organic phase as $NbO(OH)_2(H_2O_2)R$ and $Ta(OH)_4(H_2O_2)R$ complexes where R is the DBPA anion. The extraction constants of the niobium and tantalum peroxide complexes are respectively 20.1 ± 1.0 and 8.6 ± 0.8. (auth)

14797 SYNTHESIS OF A POORLY CRYSTALLINE TITANIUM TUNGSTATE. SEPARATION OF Hf^{4+} FROM Zr^{4+} AND OF La^{3+} FROM Ce^{3+}, Pr^{3+}, Nd^{3+}, AND Sm^{3+}. Qureshi, Mohsin; Gupta, Jai Prakash (Aligarh Muslim Univ., India). J. Chromatogr.; 62: No. 3, 439-48(25 Nov 1971).

A poorly crystalline titanium tungstate sample with a Ti : W ratio of 1 : 1.3 was synthesized by mixing 0.5M solutions of titanic chloride and sodium tungstate in the volume ratio 1 : 1. After precipitation at pH 0, the precipitate obtained was refluxed with its mother liquor for 12 hours. A comparison of the ion-exchange properties of the various titanium tungstates shows that as the W : Ti ratio increases, the chemical stability and ion-exchange capacity (at 40 and 100°) also increase until the capacity becomes a maximum at W : Ti = 1 : 1. (auth)

14798 SEPARATION OF YTTRIUM FROM THE LANTHANIDES BY ION EXCHANGE WITH DIETHYLENETRIAMINEPENTAACETIC ACID AS ELUANT. I. SEPARATION OF YTTRIUM–ERBIUM MIXTURES. Kogan, L.; Ratner, R. (Technion–Israel Inst. of Tech., Haifa). J. Chromatogr.; 62: No. 3, 449-57(25 Nov 1971).

The elution of yttrium and erbium and the separation of yttrium–erbium mixtures on a sulfonated cation exchanger comprising 4 to 5% divinylbenzene with 0.025M diethylenetriaminepentaacetic acid (DTPA) solution was investigated at room temperature. The retaining ion was H^+ and the pHs of the eluting solutions were between 6.0 and 8.5. The composition of the lanthanide bands under equilibrium conditions was determined, the reactions involved were considered, and the height equivalent to a theoretical plate was determined as a function of the grain size. For the pH range studied, the leakage of $NH_4^+ + H^+$ into the lanthanide band was about 40%. The mole fraction of erbium and yttrium in the resin band decreased with decreasing pH of the eluant. The concentration of Y^{3+} and Er^{3+} in the effluent increased from 38.5 and 39.6 mequiv/l at pH 6.10 to 51.0 and 49.8 mequiv/l at pH 8.15, respectively. The heights equivalent to a theoretical plate, in separations with resin particles of 20 to 50 and 52 to 100 mesh with all other conditions remaining constant, were 1.95 cm and 0.99 cm, respectively. (auth)

14799 ION EXCHANGE METHODS OF SEPARATION IN THE ANALYTICAL CHEMISTRY OF METALS: SURVEY. Chernobrov, S. M. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 1, 1-10(Jan 1971).

Translated from Zavod. Lab.; 37: No. 1, 1-8(Jan 1971).

A review is presented of ion exchange methods of separation in the analytical chemistry of metals including alkali metals, alkaline earth metals, rare earths, scandium, titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, manganese, zinc, cadmium, copper, iron, cobalt, nickel, aluminum, indium, gallium, thallium, germanium, tin, lead, antimony, bismuth, thorium, and uranium. (130 references) (D.H.M.)

14800 STUDIES OF THE SOLVENT EXTRACTION OF $^{175,181}Hf(IV)$ BY DIBUTYL PHOSPHATE (HDBP), DI(2-ETHYLHEXYL) PHOSPHATE (HDEHP) IN HEXANE AND TOLUENE. Liem, Djiet Hay; Sinegribova, Oksana (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 25: No. 1, 277-97(1971).

The extraction of $^{175,181}Hf(IV)$ was studied from 1.0(0.5) M H_2SO_4 and 1.0 M $HClO_4$ aqueous solution into hexane and toluene by dibutyl phosphate or di(2-ethylhexyl) phosphate (=HA). The distribution data were computer-analyzed with the LETAGROPVRID program and the results indicate the formation of $Hf(SO_4)^{2+}$ and $Hf(SO_4)_2$ complexes in the aqueous phase and the following extractable Hf(IV)-species: in hexane with HA = HDBP: HfA_4, $HfA_4(HA)$, $HfSO_4A_2(HA)_2$, and $HfSO_4A_2(HA)_3$, and in toluene with HA = HDEHP: $HfA_4(HA)$ and $HfA_4(HA)_2$. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 15632 and 15650.

14801 ABSTRACTS OF PAPERS. 161st National Meeting, American Chemical Society, Los Angeles, California, March 28–April 2, 1971. Washington, D. C.; American Chemical Society (1971). 892p. $4.00. (CONF-710343-(Absts.)).

Chemical and Physical-Chemical Properties

Refer also to abstracts 15013, 15024, 15031, 15065, 15594, 15595, 15746, 15786, and 16126.

14802 SOME EXPERIMENTAL AND THEORETICAL CORRELATIONS FOR THE USE OF FUNDAMENTAL HARMONIC ALTERNATING CURRENT POLAROGRAPHY. Bond, A. M. (Univ. of Melbourne, Parkville, Australia). Anal. Chem.; 44: No. 2, 315-35(Feb 1972).

Some experimental and theoretical correlations that can be used to assign the different types of ac electrode processes are described, and the relative merits of the different types of electrode processes in the analytical use of ac polarography are considered in an endeavor to encourage a systematic and logical approach to ac polarography as is the case with dc polarography. Experimentally, reversible electrode reactions (including U(VI) + e ⇌ U(V)) were used to obtain parameters in order to assign a reversible ac electrode process. (J.G.B.)

14803 LUMINESCENCE QUENCHING AND ENERGY MIGRATION IN URANYL SALTS. Abramov, A. P.; Abramova, I. N.; Tolstoi, N. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 30: No. 3, 259-62(Mar 1971).

Translated from Opt. Spektrosk.; 30: No. 3, 472-8(Mar 1971).

The coefficients of bimolecular recombination were measured for excitations during nonlinear quenching in a series of uranyl salts. The results were used to estimate the probability of excitation-energy migration. Values for migration probabilities were obtained also from experiments with the formation of stable photogenic quenching centers in uranyl salts. The two estimates are in good agreement. A calculation of the migration probability was carried out for the uranyl salts investigated according to Dexter's formula for a dipole–dipole interaction. It is shown that the calculation of the dipole–dipole interaction is insufficient to obtain conformity of the theory with experimental data. (auth)

14804 CALCULATION OF THE IN-PLANE VIBRATIONS OF 9,10-ANTHRAQUINONE AND 9,10-ANTHRAQUINONE-d_8. II. Strokach, N. S.; Gastilovich, E. A.; Shigorin, D. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 30: No. 3, 238-40(Mar 1971).

Translated from Opt. Spektrosk.; 30: No. 3, 433-6(Mar 1971).

The in-plane vibrations of 9, 10-anthraquinone and 9, 10-anthraquinone-d_8 have been calculated using the force field of benzene, which has the following advantages over the force field used in a previous calculation: (1) it gives values for the Coriolis constants in C_6H_6 and C_6D_6 close to the experimental values; (2) it reflects to a greater extent the fractional order of the C...C bond in benzene. The assignment made in a previous paper has been fully confirmed, and a new system of force constants for the molecules studied has been obtained. (auth)

14805 PRODUCTION AND STUDY OF SOME PHYSICOCHEMICAL PROPERTIES OF UOF(OH).0.5H_2O. Vdovenko, V. M.; Romanov, G. A.; Malinin, G. V.; Solntseva, L. V. Sov. Radiochem. (Engl. Transl.); 12: No. 5, 727-9(Sep-Oct 1970).

Translated from Radiokhimiya; 12: No. 5, 762-4(Sep-Oct 1970).

A compound with the composition UOF(OH) · 0.5H_2O was produced. Chemical and thermal analyses of the compound were conducted. The ir spectra were taken to confirm the chemical formula of the substance. (auth)

14806 HEAT OF FORMATION OF UOF(OH).0.5H_2O. Vdovenko, V. M.; Romanov, G. A.; Solntseva, L. V. Sov. Radiochem. (Engl. Transl.); 12: No. 5, 730-1(Sep-Oct 1970).

Translated from Radiokhimiya; 12: No. 5, 764-6(Sep-Oct 1970).

The heat of solution of UOF(OH) · 0.5H_2O in hydrochloric acid was determined. The dissociation pressure of UOF(OH) · 0.5H_2O was investigated. The heat of formation of anhydrous UOF(OH) was calculated from the data obtained. (auth)

14807 NEW CLASS OF HETEROPOLY COMPOUNDS: THE THORIUM OCTOTUNGSTATES. Marcu, Gh.; Todorut, I.; Botar,

A. (Inst. of Chemistry, Cluj). Rev. Roum. Chim.; 16: No. 9, 1335-9(Sep 1971). (In German).

Five salts of the new heteropolyanion $(ThW_8O_{28})^{4-}$ were synthesized. This heteropolyanion contained tetravalent thorium and tungsten anhydride. Through chemical and thermogravimetric analysis, the general formula of these heteropolysalts was determined as: $Me_4^I(ThW_8O_{28})\cdot xH_2O$, in which $Me^I = Na^+$, K^+, Rb^+, Cs^+, and NH_4^+. Several physical and chemical properties of these salts were studied and possibilities of their use for analytical purposes were pointed out. (tr-auth)

14808 HETEROPOLYTUNGSTATES OF U(IV). III. STUDIES OF THE ABSORPTION AND REFLECTION SPECTRA AS WELL AS THE MAGNETIC PROPERTIES. Marcu, Gh.; Botar, A. (Inst. of Chemistry, Cluj). Rev. Roum. Chim.; 16: No. 9, 1341-6(Sep 1971). (In German).

Absorption and reflection spectra as well as magnetic properties were studied of the heteropolytungstates $Na_4(UW_8O_{28})\cdot 24H_2O$ and $Na_6(UThW_{16}O_{61})\cdot 55H_2O$. Results showed that these heteropolytungstates could be ranked in the class of octo-coordinated U(IV) compounds with regular symmetry; this fact was supported by a magnetic moment of $\mu_{eff} = 2.8$ M.B. Consequently, these U(IV) compounds showed a cubic symmetry. (tr-auth)

14809 ADSORPTION OF EUROPIUM ON A $BaSO_4$ PRECIPITATE. Grebenshchikova, V. I.; Davydov, Yu. P.; Pershin, A. S. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 460-1(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 444-5(May-Jun 1971).

On the basis of the data obtained it was concluded that both at pH = 3.0 and at pH = 6.2 (the region preceding the formation of europium hydroxide), europium is adsorbed on $BaSO_4$ in the form of the Eu^{3+} ion. (auth)

14810 URANIUM, ARSENIC, ANTIMONY, AND MOLYBDENUM OXIDATION CATALYSTS AND PROMOTERS THEREFOR. (to Standard Oil Co.). British Patent 1,257,335. 15 Dec 1971. Priority date 20 Dec 1967, United States.

A method is described for the preparation of oxidation catalysts comprising oxides of U, As, Sb, and Mo optionally incorporating promoters, which are useful for the catalytic oxidation of olefins to unsaturated aldehydes and acids and conjugated dienes, and for the catalytic ammoxidation of olefins to unsaturated nitriles. The catalysts are prepared by forming a mixture of the aqueous solutions of the salts of at least two of the elements, adding to the mixture a sufficient quantity of a dispersion of a catalyst support, continuously heating while stirring until the resulting mixture is gelled, and treating the gelled mixture at a temperature of at least 500°F in the presence of oxygen and in the absence of a reducing gas. (P.C.H.)

14811 ELECTROKINETIC PROPERTIES OF A SUSPENSION OF $BaSO_4$. Grebenshchikova, V. I.; Davydov, Yu. P.; Pershin, A. S. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 390-4(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 375-80(May-Jun 1971).

It was established that H^+ ions recharge the surface of a $BaSO_4$ suspension (they change the sign of the ζ-potential). Europium ions recharge the surface of a $BaSO_4$ suspension at pH = 6.2 and do not recharge it at pH = 3.0 (they change the sign of the ζ-potential). It was hypothesized that the recharging of a suspension of $BaSO_4$ is due to adsorption of hydrolyzed europium ions. (auth)

14812 EXPERIMENTAL INVESTIGATION OF THE ENTHALPY OF SATURATED HEAVY-WATER LIQUID. Nowak, E. S.; Chan, J. (Univ. of Western Ontario, London). J. Heat Transfer; 93: No. 4, 422-6(Nov 1971).

Measurements on the enthalpy of saturated heavy water liquid were made for temperatures ranging from 90 to 350°F by means of a non-flow, continuous-heating calorimeter. Based on confirmatory tests conducted on light water, it is estimated that the heavy water enthalpy measurements are accurate to ±0.5%. The experimental data of this research is in reasonable accord with the data obtained by other investigators. It was also found that the difference between the heavy water enthalpy-change values and the corresponding values for light water is a strong function of temperature varying from about 0.2% at 100°F to 3.5% at 350°F. (auth)

14813 HYDROGEN ATOM LOCATIONS IN THE α AND β FORMS OF URANYL HYDROXIDE. Taylor, J. C.; Hurst, H. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Acta Crystallogr., Sect. B; 27: 2018-22(15 Oct 1971).

The hydrogen atoms in the α and β forms of uranyl hydroxide were located by neutron diffraction and nuclear magnetic resonance methods. Least-squares refinement of the neutron powder data gives a discrepancy factor, $R = [\Sigma\omega(F_o^2 - F_c^2)^2]^{\frac{1}{2}}/[\Sigma\omega(F_o^2)^2]^{\frac{1}{2}}$, of 0.10 for the α form and 0.06 for the β form. The uranyl hydroxide layers in both forms are linked with O(hydroxyl)$-$H$\cdots$O(uranyl) hydrogen bonds of length 2.76(8) Å in the α form and 2.80(6) Å in the β form. (auth)

14814 HYDROLYSIS OF PLUTONYL ION IN SODIUM PERCHLORATE MEDIUM. Schedin, Ulla (Research Inst. of National Defence, Sundbyberg, Sweden. Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 25: 747-8(1971).

By EMF titrations of the hydrolysis of plutonyl ion in 3M $NaClO_4$ the complex (2.2) was found to be dominating in the region investigated. Calculation of the equilibrium constant gave: $\log \beta_{2,2} = -8.21 \pm 0.02$ with $\sigma(Z) = 0.010$. (Denmark)

14815 SOME THEORETICAL AND APPLICATIVE ASPECTS CONCERNING THE ELECTROCHEMICAL STUDY OF MELTED MEDIA. Raducanu, I. C. Rev. Chim. (Bucharest); 22: No. 9, 556-62(Sep 1971). (In Rumanian).

Some theoretical aspects concerning systems formed from melted media as well as a series of technical applications of the electrolysis of these systems are reviewed. Information is tabulated on several galvanic systems, including U, $UF_3(s)-UF_3$, UC_2, and U_2C_3 at 700 to 900°C, Pt$-$U, $UI_3(s)-NaI(s)-AgI(s)-Pt$ at 220 to 370°C, and air$-$Pt$-ThO_2$ at 700 to 1100°C. The study also deals with the electrochemical synthesis of some chemical compounds with special properties and particularly the electrocrystallization from melting media of some refractory metals (or alloys) such as Cr, Ti, Zr, Nb, Ta, and Mo, which are of major importance in many technical fields. (auth)

14816 DISSOCIATION CONSTANT OF ACENAPHTHENEQUINONE MONOXIME AND STABILITY CONSTANTS OF ITS COMPLEXES WITH UO_2(II), Cu(II), Pb(II), Zn(II), Ni(II), Mn(II), AND Mg(II). Sindhwani, S. K.; Singh, R. P. (Univ. of Delhi). Indian J. Chem.; 9: No. 9, 1000-1(Sep 1971).

The dissociation constant of acenaphthenequinone monoxime was determined by a solubility method. The value was found to be $10^{-9.30\pm0.02}$. Stability constants of some bivalent metal complexes with the ligand were determined by a potentiometric method in 75% dioxane medium, in which both the ligand and metal complexes are soluble. The order of stability was found to decrease in the order $UO_2^{2+} > Cu^{2+} > Pb^{2+} > Zn^{2+} > Ni^{2+} > Cd^{2+} > Mn^{2+} > Mg^{2+}$, which is in agreement with the order of Irving and Williams and Maley and Mellor. (auth)

14817 ANNUAL REVIEW OF PHYSICAL CHEMISTRY. VOLUME 22. Eyring, H. (ed.). Palo Alto, Calif.; Annual Reviews Inc. (1971). 648p.

Separate abstracts were prepared for three of the seventeen papers included. The remaining papers are outside the scope of Nuclear Science Abstracts. (A.G.W.)

For abstracts of individual papers see: 14982, 16143, and 16172.

Isotope Effects

Refer also to abstracts 14999, 16127, and 16128.

14818 ENTHALPIES AND EXCESS ENTHALPIES OF TRANSFER OF n-ALKYLAMINE HYDROBROMIDES FROM H_2O TO D_2O AT 25°C. Desnoyers, J. E.; Francescon, R.; Picker, P.; Jolicoeur, C. (Univ. of Sherbrooke, Quebec). Can. J. Chem.; 49: No. 21, 3460-7(1 Nov 1971).

Differences in heats of solution and in heats of dilution of electrolytes in H_2O and D_2O were measured directly with a previously described cell-type differential microcalorimeter. In addition to NaCl and NaBr, most of the homologous salts RNH_3Br were studied from R = methyl to R = n-octyl. The results of the two simple salts are in excellent agreement with the best literature values. The enthalpies of transfer at infinite dilution, $\Delta H_{tr}^0(H_2O \rightarrow D_2O)$, are mainly a measure of the structural ion$-$solvent interactions and of the exchange reaction $RNH_3^+(D_2O) + 3D_2O \rightarrow RND_3^+(D_2O) + 3HDO$. Up to R = n-propyl, the relative apparent molal enthalpies of transfer, $\Delta\phi_L(H_2O \rightarrow D_2O) = \Delta H_{tr}^{EX}$, are negative, approximately zero for n-butyl and positive for the higher members. This gradual change in the excess enthalpies of transfer is interpreted in terms of the increasing importance of hydrophobic interactions between the cations. When association occurs through micelle formation (R = n-octyl), there is a rapid increase in $\Delta\phi_L(H_2O \rightarrow D_2O)$, which results from hydrophobic bonding. (auth) (Canada)

14819 ^{15}N ISOTOPIC EFFECTS ON THE INFRARED SPECTRUM OF UREA ($^{15}NH_2CO^{14}NH_2$ AND $^{15}NH_2CO^{15}NH_2$). Arenas, J.; Parellada, R. (Junta de Energia Nuclear, Madrid). J. Mol. Struct.; 10: No. 2, 253-64(Nov 1971).

Both molecules $CO(^{15}NH_2)_2$ and $^{15}NH_2CO^{14}NH_2$ were synthesized

with a 95% ^{15}N isotopic content in the substituted positions. The isotopic shifts were measured and interpreted in the 4000 to 400 cm^{-1} region. Those of the 712 cm^{-1} and 527 cm^{-1} bands could be assigned to the out-of-plane $t(NH_2)b_2$ and $w(NH_2)b_2$ vibrations, respectively; furthermore, the assignment of the 1055.3 cm^{-1} band to the $r(NH_2)b_1$ vibrations was confirmed. The isotopic product rule and sum rule are in accordance with the proposed assignments. (auth)

14820 MECHANISM OF THE AROMATIZATION OF ARENE OXIDES. Kasperek, George J.; Bruice, Thomas C. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 94: No. 1, 198-202(12 Jan 1972).

The kinetics of the aromatization of arene oxides was studied at 30° ($\mu = 1.0$) between pH 2.5 and 14.0. The pH−log k_{obsd} profiles for benzene oxide and naphthalene oxide are characterized by a straight line of slope —1.0 in the acid region in agreement with specific acid catalysis, and a plateau in the pH > 7 region indicating a spontaneous aromatization. With phenanthrene oxide only the acid-catalyzed portion was detected. For the spontaneous aromatization the entropy of activation ($\Delta S^{\ddagger} = -25.7$), solvent deuterium kinetic isotope effect ($k_1^{H_2O}/k_1^{D_2O} = 1.33$) at pH 12, and the established requirement of the NIH shift are in accord with a mechanism involving a rate-determining 1,2-hydride shift to form an enone which rapidly tautomerizes to the phenolic product. The detailed mechanism is discussed in light of the experimental data. (auth)

14821 ISOTOPE EFFECTS IN LIQUID DIFFUSION. Eppstein, Lee Bernhardt. Fort Worth, Tex.; Texas Christian Univ. (1971). 100p. University Microfilms Order No. 71-29,609.

Thesis.

The self-diffusion coefficient of benzene was measured using benzene-1-^{14}C and benzene-1,2-^{14}C tracers. These data are compared with existing data of Birkett and Lyons for the limiting diffusion coefficient of benzene-$^2H_6$ in benzene. This comparison shows that the limiting diffusion coefficient of a tracer species is dependent on the isotopic composition of the tracer. The isotope effect study suggested that a general mass dependence for limiting diffusion data might be found. Limiting diffusion data for 24 homologous series in both polar and nonpolar solvents were correlated with the empirical relation $D = a + bM^{-1/2}\bar{V}^{-1/6}$. For nonassociating solutes in unassociated solvents the value of a was generally small compared to the second term. The value of b was found to depend upon $M^{1/2}$ solvent, $\bar{V}^{1/6}$ solvent, η solvent. The equation may be rewritten in the form $D = a + b'(M_s^{1/2}\bar{V}_s^{1/6})/\eta_s M^{1/2}\bar{V}^{1/6})$, where the subscript s denotes a solvent property; b′ assumes a value of 1 for noncyclic solvents and a value of 1.5 for cyclic solvent. Associated solvent systems are characterized by higher values of b′. Solute association is characterized by lower values of b′ while solvent-solute association leads to high values of a and low values of b′. These generalizations were used to interpret diffusion data in aqueous systems. (Diss. Abstr. Int., B)

14822 TEMPERATURE DEPENDENCE OF THE KERR CONSTANT OF WATER. Chen, Yeong-jgi; Orttung, William H. (Univ. of California, Riverside). J. Phys. Chem.; 76: No. 2, 216-21(20 Jan 1972).

The Kerr constant of liquid water was studied from 5 to 81° at a wavelength of 365 mμ. The data suggest a $1/T^2$ dependence at the high and low ends of the temperature range, with a broad inflection point of approximately zero slope near 35°. Less complete results were obtained for D_2O from 5 to 50°. Its Kerr constant is about 10% less than that of water at 25° and 365 mμ. The inflection point could not be predicted from calculations based on temperature-dependent angular correlation of neighboring molecules unless allowance was made for a variable optical anisotropy. It was found that hyperpolarizability interaction with the strong electric field of neighboring dipoles could account for the temperature dependence of both the mean polarizability and the optical anisotropy. The effect of hydrogen bonding on the symmetry of the molecule was also considered as a factor in the temperature dependence and in the difference between H_2O and D_2O. (auth)

14823 ^{13}C ISOTOPE EFFECTS IN OXIDATION REACTIONS OCCURRING IN THE CO–O_2–NO TERNARY SYSTEM. Zielinski, Mieczyslaw (Univ., Warsaw). Nukleonika; 16: No. 5-6, 191-201(1971). (In Polish).

^{13}C isotope effects in the catalytic oxidation of carbon monoxide in the presence of different quantities of nitric oxide in the reaction vessel ranging from 2.5×10^{-2} up to 94 mmHg were investigated. It was shown that as the pressure of nitric oxide in the reaction vessel increases, fractionation of the ^{13}C between carbon dioxide and the unreacted fraction of carbon monoxide decreases and reaches a value close to 1,000 at pressures of P_{NO} between 0.05 and 0.1 mmHg and temperature 541°C. After passing the minimum the measured ^{13}C isotope effect rises up to a practically constant value. The position and the depth of the minimum on the curve "$\phi - P_{NO}$" changes with temperature. Also the value of the pressure of NO at which ϕ reaches the "plateau" depends on temperature. Depending on the temperature, the plateau is reached at pressures of nitric oxide between 5 and 15 mmHg. By comparing the isotope data obtained at $P_{NO} > 30$ mmHg with the ^{13}C isotope effect reported by Johnston and coworkers it was concluded that oxidation of carbon monoxide in the "plateau region" proceeds via a pure molecular reaction. At the minimum on the "$\phi - P_{NO}$" curve the oxidation of carbon monoxide proceeds through free radical mechanism discussed by Semenov and Crist. In the intermediate regions of nitric oxide pressures there is a mixed mechanism of oxidation: (a) free radical volume reaction and surface heterogenic reaction, and (b) free radical oxidation and molecular oxidation by nitrogen dioxide. (auth)

14824 EQUILIBRIUM NITROGEN AND OXYGEN ISOTOPE EFFECTS IN GLYCINE/GLYCINATE AND GLYCINE/GLYCINIUM SYSTEMS. Sarpal, S. K.; Gupta, A. R.; Shankar, J. (Bhabha Atomic Research Centre, Bombay). Indian J. Chem.; 9: No. 7, 682-6(Jul 1971).

Nitrogen and oxygen isotope effects in the equilibria $(H_3^{+}NCH_2COO^{-})_S/(H_3^{+}NCH_2COOH)_R$ and $(H_3^{+}NCH_2COO^{-})_S/(H_2NCH_2COO^{-})_R$ were determined using breakthrough operation on cation and anion exchange columns. The single stage separation factors, a, have been calculated from the material balance equation as well as Glueckauf's theory for breakthrough operation of ion exchange columns. The good agreements between the a-values calculated in two ways, the experimental and the theoretical breakthrough curves and the HETP calculated from nitrogen and oxygen isotope effects on the same column provide an experimental proof to the validity of Glueckauf's theory. The a values for various isotopic exchange reactions are $(H_3^{+}NCH_2COO^{-})_S/(H_2NCH_2COO^{-})_R$: $a_{14}^{15} = 1.0250$, $a_{16}^{18} = 1.0030$ and $(H_3^{+}NCH_2COO^{-})_S/(H_3^{+}NCH_2COOH)_R$: $a_{14}^{15} = 1.0099$, $a_{16}^{18} = 1.0032$. (auth)

14825 MECHANISM OF ACID HYDROLYSIS OF ARYLDIAZOMETHANES. Dahn, H.; Diderich, G. (Univ., Lausanne, Switzerland). Helv. Chim. Acta; 54: No. 7, 1950-60(1971). (In French).

In the acid catalyzed hydrolysis of three monoaryldiazomethanes (p-nitrophenyldiazomethane (I), p-chlorophenyldiazomethane (II), phenyldiazomethane (III)), absence of exchange H−D, solvent isotope effects, and general acid catalysis prove that proton transfer is rate determining (A−S_E2 mechanism). Like other A−S_E2 reactions, the hydrolysis of I is shown to obey the Brønsted catalysis law with a variety of carboxylic acids; for eight of these acids, α_B was found to be 0.69 ± 0.06. (auth)

14826 BASE-CATALYZED HYDROGEN–DEUTERIUM EXCHANGE IN SULFONIUM CATIONS. Barbarella, G.; Garbesi, A.; Fava, A. (Univ., Geneva). Helv. Chim. Acta; 54: No. 7, 2297-2307(1971).

The effects of various structural changes on the kinetic acidity of protons alpha to a sulfonium function are reported. These effects are consistent with a transition state closely resembling a carbanion. Strong rate enhancements are observed for the 4-membered cyclic sulfonium cation but not for the other ring systems. In 5-membered cyclic sulfonium cations the diastereotopic ring protons show high stereo-selectivity towards abstraction by a base. Such stereoselectivity is diminished in going from D_2O to dimethyl sulfoxide-d_6–D_2O mixtures. By contrast no stereoselectivity is exhibited by the ring protons of the 6- and 7-membered cyclic sulfonium cations. Although the rates for acyclic and cyclic sulfonium cations are closely similar, the activation parameters are characteristically different. It is suggested that solvation phenomena may be responsible for this behavior. (auth)

14827 REACTIONS OF RADICALS. I. USE OF HYDROGEN ISOTOPES IN POLYMER CHEMISTRY. II. HYDROGEN ATOM REACTIONS IN SOLUTION. Henderson, Richard Wayne. Baton Rouge, La.; Louisiana State Univ. and A and M Coll. (1971). 138p. University Microfilms Order No. 71-29,371.

Thesis.

Hydrogen secondary kinetic isotope effects in the polymerization of styrene were measured. Through combination of the deuterium and tritium effects it was possible to calculate the isotope effects for all of the various types of hydrogens in the transition state, including those in the polystyryl radical and those in the styrene monomer under attack. The isotope effects for side-chain-labeled styrenes appear to have a direct bearing on the interpretation of the isotope effects observed in [2 + 2] cycloadditions, and are discussed in that context. In an extension of these tracer studies to the styrene–maleic anhydride copolymerization system, it was found that there is no isotope effect on the cross-propagation step in which a copolymeric radical having a terminal anhydride unit attacks styrene or styrene-t. Also, the radical reactivity ratios

for the comonomers styrene–maleic anhydride were determined. Photolysis of tert-butyl peroxyformate(BUP), $H-CO_2-OC(CH_3)_3$, produces appreciable quantities of hydrogen gas, whereas thermolysis does not. Two different systems, both utilizing photolysis of BUP as a convenient source of H- atoms in solution, were developed to study the abstraction of hydrogen from organic hydrogen donors by H atoms. Substituted toluenes were used as substrates in a study of the polarity of the H atom. A rho value of −0.13 was found for hydrogen abstraction from the toluenes; this value indicates that the hydrogen atom, like the methyl and phenyl radicals, is only slightly electrophilic. (Diss. Abstr. Int., B)

14828 HOFMANN REARRANGEMENT. IV. KINETIC ISOTOPE EFFECT OF N-CHLOROBENZAMIDE. Imamoto, Tsuneo; Kim, Seung-geon; Tsuno, Yuho; Yukawa, Yasuhide (Osaka Univ.). Bull. Chem. Soc. Jap.; 44: No. 10, 2776-9(Oct 1971).

Kinetic isotope effects in the Hofmann rearrangement of phenyl-1-^{14}C and carbonyl-^{14}C labeled N-chlorobenzamides were measured in a sodium hydroxide solution at 15°C. The observed isotope effect on the phenyl-1-carbon is $k_{12}/k_{14} = 1.0456 \pm 0.0012$ and that on the carbonyl-carbon is $k_{12}/k_{14} = 1.0447 \pm 0.0006$. These results strongly support a concerted mechanism for this rearrangement. Attempts have been made to correlate the isotope effect on phenyl-1-carbon to the r-value of the linear aromatic substituent-reactivity relationship in related 1,2-rearrangements. (auth)

14829 3020-cm^{-1} BAND IN THE INFRARED ABSORPTION SPECTRA OF METHYL ESTERS OF UNSATURATED HIGHER FATTY ACIDS. Hirabayashi, Yoshio; Kato, Nobukatsu; Mizuta, Masateru; Ishihara, Hideharu (Gifu Univ., Japan). Bull. Chem. Soc. Jap.; 44: No. 10, 2733-6(Oct 1971).

Studies were made of the infrared absorption spectra of methyl esters of oleic, elaidic, linoleic, linoelaidic, trans-10, cis-12-octadecadienoic, α-eleostearic, stearolic, stearic, 9,10-dideutero-oleic, and 9,10-dideutero-elaidic acids in the C—H stretching region. It was further confirmed that the prominent absorption bands at 3020 cm^{-1} occurring in the infrared absorption spectra of methyl esters of unsaturated higher fatty acids are assignable to the =C—H stretching vibrations of a cis-ethylenic double bond. The =C—D stretching vibrations of deuteroethylenic double bonds (–CD=CD–) in methyl 9,10-dideutero-oleate and -elaidate occurred at 2250 and 2225 cm^{-1}, respectively. (auth)

14830 DEUTERIUM ISOTOPE EFFECT ON THE FLUORESCENCE LIFETIME OF AZULENE. Knight, A. E. W.; Selinger, B. K. (Australian National Univ., Canberra). Chem. Phys. Lett.; 12: No. 2, 419-21(15 Dec 1971).

The fluorescence lifetime of azulene-d_8 was found to be longer than that of azulene-h_8 both in frozen solution and under collision-free conditions in the vapor. The lifetime of the emission of the isolated molecule decreases with higher energy excitation. (auth)

14831 MEASUREMENT OF THE DIFFUSION AND ISOTOPE EFFECTS OF SILVER IN LEAD. Herzig, Chr.; Heumann, Th.; Wolter, D. (Univ., Muenster, Ger.). Z. Naturforsch.; 26a: No. 9, 1477-84(Sep 1971). (In German).

The diffusion and the isotope effect of silver in lead was investigated to explain the diffusion mechanism. The measured diffusion coefficients agree very well with the values of other authors. The isotope effect of ^{105}Ag and ^{111}Ag on diffusion of silver in lead was determined by the usual layer separation method. The separation of the pulse rate of the two isotopes was done on the basis of their different half-lives and on the basis of their different decay properties (β-γ separation). The value $E \cong 1$ was determined for the isotope effect. This result shows that the diffusion of Ag in Pb proceeds by the interstitial lattice plates. (tr-auth)

14832 HYDROGEN EXCHANGE IN PROTEINS. EQUILIBRIUM AND KINETIC ISOTOPE EFFECTS IN BOVINE PLASMA ALBUMIN STUDIED WITH TRITIUM AND DEUTERIUM. Hallaway, Ben E.; Benson, E. S. (Univ. of Minnesota, Minneapolis). Biochim. Biophys. Acta; 243: No. 3, 380-7(1971).

Isotope effects were investigated by comparing the rates of back exchange of tritium and deuterium from bovine plasma albumin to water at different pH values and at 25°. At times less than 8 h there is more exchange of deuterium than of tritium at both pH 5 and 7.2. This difference is considered to be due to a kinetic isotope effect on exchange rates. After 24 h, when apparent exchange equilibrium was reached, the extent of exchange is the same with both isotopes indicating the absence of a significant equilibrium isotope effect between deuterium and tritium. (auth)

14833 METAL ISOTOPE EFFECT ON METAL-LIGAND VIBRATIONS. V. CIS AND TRANS Ni(II) PHOSPHINE–HALIDE COMPLEXES. Udovich, Carl; Takemoto, James; Nakamoto, Kazuo (Marquette Univ., Milwaukee). J. Coord. Chem.; 1: No. 2, 89-93(Nov 1971).

Infrared spectra (4000 to 200 cm^{-1}) were reported for Ni(DPE)X_2 where X is Cl, Br, and I and DPE is 1.2-bis(diphenylphosphino)-ethane. The Ni–X and Ni–P stretching bands were assigned based on the observed isotopic shifts due to the ^{58}Ni–^{62}Ni substitution. The Ni–X stretching frequencies are always lower and the Ni–P stretching frequencies are always higher in the cis-complexes such as Ni(DPE)X_2 than in the corresponding trans-complexes such as Ni$(PEt_3)_2X_2$. These differences between cis and trans configurations have been attributed to the strong trans-effect of phosphine ligands. (auth)

14834 VIBRATIONAL SPECTRA OF $(t\text{-}C_4H_9{}^6Li)_4$ AND $(t\text{-}C_4H_9{}^7Li)_4$. RAMAN INTENSITIES AND THE QUESTION OF Li–Li BONDING. Scovell, W. M.; Kimura, B. Y.; Spiro, T. G. (Princeton Univ., N. J. Univ. of Illinois, Urbana). J. Coord. Chem.; 1: No. 2, 107-14(Nov 1971).

Raman frequencies and intensities in methylcyclohexane solution and infrared frequencies in Nujol mull, were obtained and assigned for the skeletal modes of $(t\text{-}C_4H_9{}^6Li)_4$ and $(t\text{-}C_4H_9{}^7Li)_4$. A normal coordinate analysis, neglecting hydrogen atoms, gave an overall frequency fit of 2% with a reasonable set of valence force constants. The calculated eigenvectors were used to transform the Raman intensities into bond polarizability derivatives. Because of coordinate mixing and the inherent sign ambiguity of molecular polarizability derivatives, there are eight sets of bond polarizability derivatives, which are consistent with the measured intensities. Only one set, however, gives reasonable polarizability derivatives for CC stretching and CCC bending, and also shows the requisite invariance to isotope substitution. This set gives a low value for the Li–Li polarizability derivative, and application of the delta function potential equation suggests that the extent of Li–Li bonding is small, amounting to perhaps 5% of the total bonding electron density in the Li_4C_4 cage. This conclusion is consistent with the failure to observe Li–Li spin-spin coupling in $(t\text{-}C_4H_9Li)_4$. (auth)

14835 ISOTOPE EFFECTS IN PROTON-TRANSFER REACTIONS. I. BASE CATALYZED RACEMIZATION OF 2-METHYL-3-PHENYLPROPIONITRILE IN DIMETHYL SULFOXIDE–METHANOL SOLUTIONS. Melander, Lars; Bergman, Nils-Ake (Univ. of Goteborg. Chalmers Inst. of Tech., Goteborg). Acta Chem. Scand.; 25: No. 6, 2264-72(1971).

The deuterium isotope effect was measured in the racemization of 2-methyl-3-phenylpropionitrile in different mixtures of dimethyl sulfoxide and methanol with sodium methoxide as base. A smooth variation of the kinetic isotope effect was observed. In pure methanol, $k_D/k_H = 0.87 \pm 0.04$, and in 90.2% DMSO–9.8% methanol, $k_D/k_H = 0.67 \pm 0.02$ at 60.0°C. The strength of the isotope effect and its variation are interpreted in terms of an unsymmetric transition state for the proton transfer. (auth)

14836 ^{1}H AND ^{2}H SPECTRA OF ETHYL BROMIDE. Jensen, H.; Schaumburg, K. (H. C. Oersted Inst., Copenhagen). Acta Chem. Scand.; 25: No. 2, 663-8(1971).

Hydrogen-1 NMR spectra of ethyl bromide and deuterium-labeled ethyl bromides were observed, and the chemical shift and coupling constants determined. The results were $^2J(CH_3) = -13.1$ Hz; $^2J(CH_2Br) = -9.3$ Hz; $^3J = 7.2$ Hz. ^{2}H spectra of the deuterated species were recorded and analyzed. The coupling constants and chemical shifts obtained were in close agreement with the data obtained from ^{1}H data. Geminal and vicinal isotope effects on chemical shift were measured in ^{1}H NMR spectra relative to ethyl bromide as internal standard. The geminal isotope effect was determined to be $\sim 14 \times 10^{-3}$ ppM and the vicinal effect $\sim 7 \times 10^{-3}$ ppM. (auth)

14837 ISOTOPE EFFECT IN CATALYZED HYDROGEN EXCHANGE REACTION. Yakushin, F. S.; Ranneva, Yu. I.; Marchenko, V. A.; Romanskii, I. A.; Shatenshtein, A. I. (Physical-Chemical Inst., Moscow). Kinet. Katal.; 12: No. 3, 591-4(May-Jun 1971). (In Russian).

Diphenylmethane was labelled with deuterium and tritium in the methylene group for the purpose of studying the kinetics and the isotope effect in the system tertiary butanol–methyl sulfoxide. Either K or Li tertiary butylate was used as a catalyst, and the rate constant ratio k_D/k_T was determined for varying mole ratios of methyl sulfoxide in alcohol as the solvent. The ratio k_D/k_T was found to be a function of the solvent composition, attaining a maximum at about 60 mole% methyl sulfoxide. (K.S.W.)

14838 HARMONIC WAVENUMBERS AND NORMAL COORDINATES FOR PYRAMIDAL MOLECULES OF THE TYPE XYZ_2 (Y IS N, P, As, Sb; X, Z ARE H, D, T). Whitmer, John C. (Western Washington State Coll., Bellingham). J. Chem. Phys.; 56: No. 3, 1050-7(1 Feb 1972).

Using a harmonic general valence force previously determined for NX_3, PX_3, AsX_3, and SbX_3 (X is H, D, T), the harmonic wavenumbers and normal coordinates were calculated for pyramidal

molecules of the type XYZ_2 (Y is N, P, As, Sb; X, Z are H, D, T). For the nitrogen molecules, harmonic wave-numbers also were obtained for the ^{15}N and hypothetical molecules in which X and Z take on masses of 6, 20, and 1000 amu. The wavenumbers for the nitrogen molecules, XNH_2, XND_2, and XNT_2 over the range X = 1–1000 amu, and HNZ_2, DNZ_2, and TNZ_2 over the range Z = 1–1000 amu are plotted. (auth)

14839 MICROWAVE SPECTRA OF IODOGERMANE AND BROMOGERMANE. Wolf, Stephen N.; Krisher, Lawrence C. (Univ. of Maryland, College Park). J. Chem. Phys.; 56: No. 3, 1040-9(1 Feb 1972).

Measurements were made of the pure rotational spectra of four isotopic species of GeH_3I and six species of GeH_3Br, using a microwave spectrometer. The Ge–I bond length derived from the analysis is 2.5075 ± 0.0006 Å. Hyperfine structure in the spectrum due to quadrupole coupling and centrifugal distortion gave an iodine quadrupole coupling constant eQq = –1281 ± 4 MHz and a centrifugal distortion constant D_{JK} = 0.0077 ± 0.0002 MHz. The results obtained for GeH_3Br are: Ge–Br bond length, 2.2970 ± 0.0002 Å; eQq (^{79}Br) = 384 ± 2 MHz; eQq (^{81}Br) = 321 ± 3 MHz; and D_{JK} = 0.013 ± 0.001 MHz. (auth)

14840 ION CYCLOTRON RESONANCE STUDY OF THE MECHANISMS OF CHEMICAL IONIZATION OF SELECTED HYDROCARBONS USING METHANE REAGENT GAS AND ION-MOLECULE REACTIONS IN HYDROGEN. Clow, Roger Paul. Salt Lake City; Univ. of Utah (1971). 135p. University Microfilms Order No. 72-1125.

Thesis.

Ion motions in electric and magnetic fields are briefly discussed with particular emphasis on the development of an ion cyclotron resonance (ICR) mass spectrometer for the study of ion-molecule reactions. This instrument is used to study mechanisms of chemical ionization (CI) of selected C_6 hydrocarbons with methane reagent gas; and to quantitatively study isotope effects, rates, and energy dependence of ion-molecule reactions in hydrogen and isotopic hydrogen. Ion-molecule reactions in hydrogen, deuterium, and hydrogen deuteride: $H_2^+ + H_2 \xrightarrow{k_1} H_3^+ + H$, $D_2^+ + D_2 \xrightarrow{k_1} D_3^+ + D$, and

$$HD^+ + HD \underset{k_{9b}}{\overset{k_{9a}}{\rightleftharpoons}} H_2D^+ + D \quad \text{and the crossed reactions}$$

$$H_2^+ + D_2 \underset{k_{9b}}{\overset{k_{9a}}{\rightleftharpoons}} H_2D^+ + D \quad \text{and} \quad D_2^+ + H_2 \underset{k_{9b}}{\overset{k_{9a}}{\rightleftharpoons}} H_2D^+ + D$$

were studied. Multiple resonance and multiple pulse techniques were used to evaluate isotope effects and effects of ion kinetic energy on these reactions. (Diss. Abstr. Int., B)

14841 KINETIC SOLVENT ISOTOPE EFFECT FOR THE SPONTANEOUS SOLVOLYSIS OF ACETIC AND PROPIONIC ANHYDRIDES. Robertson, R. E.; Rossall, B.; Redmond, W. A. (Univ. of Calgary, Alberta). Can. J. Chem.; 49: No. 22, 3665-70(15 Nov 1971).

The large kinetic solvent isotope effects for the neutral hydrolysis of acetic and propionic anhydride show unusual temperature dependency; the former passing through a maximum at about 15°, the latter showing a minimum at 30°. This unusual temperature dependency is the consequence of widely different values of the apparent $\Delta C_p^{\ddagger}$ in H_2O and D_2O: the value for acetic anhydride in H_2O being –74 ± 2 cal deg^{-1} $mole^{-1}$ but –32 ± 4 in D_2O. The corresponding values for propionic anhydride being –31 ± 2 in H_2O but –94 ± 10 in D_2O. The implications of these differences are discussed. (auth) (Canada)

Isotope Exchange and Isotope Separation

Refer also to abstract 15053.

14842 (CONF-680423–, pp 195-200) ISOTOPIC EXCHANGE BETWEEN SILVER (I) AND SILVER IN VARIOUS STAGES OF OXIDATION. Servian, Jorge L.; Buenafama, Hector D. (Universidad de la Republica, Montevideo (Uruguay). Facultad de Quimica). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The isotopic exchange between the silver(I) ions in aqueous solution and the oxides Ag_2O and AgO were studied experimentally. The values of the rate constants and mean time for the $Ag_2O_{(s)}/Ag^+_{(aq)}$ and $AgO_{(s)}/Ag^+_{(aq)}$ for different concentrations, specific activities, and n_s/n_t were determined. The exchange between Ag(I) and (III) and the structure of AgO were determined. The actual structure of AgO should be intermediate between Ag–O–Ag=O and Ag=O. (J.S.R.)

14843 (CONF-680423–, pp 290-5) ISOTOPIC EXCHANGE IN THE EVALUATION OF THE FERTILITY OF VOLCANIC SOILS. Behrens, H.; Lopez, A.; Alamos, P.; Palma, T. (Chile Univ., Santiago. Laboratorio de Radioquimica). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The relation determined previously between the fixation of the orthophosphate ion and the Al extractable from the soil at pH 4.8 was used to study isotopic exchange in soils. The apparent exchange rate is appreciably different in the five soils studied. (J.S.R.)

14844 (CONF-680423–, pp 296-8) ZERO-TIME ISOTOPIC EXCHANGE IN THE IODINE–ALKYL HALIDE SYSTEM. Behrens, H. (Chile Univ., Santiago. Laboratorio de Radioquimica); Svoboda, K.; Recke, W.; Godoy, J.; Soriano, A. (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

Recent studies have shown that there is a marked dependence between the zero-time exchange (usually called "induced in the separation") which depends on the initial concentration of iodine in the alkyl halide in a system free from oxygen. The present study confirms the existence of this process in the iodine–n-propyl iodide system in the absence and presence of air. (tr-auth)

14845 (CONF-680423–, pp 314-25) ELECTRON TRANSFERENCE ISOTOPIC EXCHANGE. Servian, Jorge L. (Comision Nacional de Energia Atomica, Montevideo (Uruguay)). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The electron transfer isotopic exchange reaction is a special type of redox reaction. The mechanism of these reactions is reviewed. Three cases are considered: transfer exchange reactions by electron solvation, by external sphere mechanism, and by internal sphere mechanism. (J.S.R.)

14846 (NYO–4266-1) CARBON ISOTOPE FRACTIONATION. Annual Progress Report, March 1, 1971–December 21, 1971. Ishida, Takanobu (Brooklyn Coll., N. Y.). 10 Jan 1972. Contract AT(30-1)-4266. 40p. (COO–3127-1). Dep. NTIS.

Various gas-handling equipment was constructed for investigation of the feasibility of low-temperature distillation of Freons as a process for carbon-13 isotope fractionation. They are: a Bigeleisen-type low-temperature distillation column; an all stainless steel vacuum system for column evacuation, column loading, and for sampling from the condenser and boiler sections of the column; a gas-chromatographic purification system, to be used for the chemical purification of Freons for distillation; and a general-purpose vacuum line, which includes a combustion train for converting Freon into carbon dioxide for the purpose of mass-spectrometric carbon-isotope analysis. The zero-point energy shifts on condensation due to the London dispersion force in the liquid phase were compared for Freons-11, 12, 13, 14, 21, 22, and 23. The theoretical investigation revealed that the carbon-13 substitution in Freon-12 is most likely to produce an inverse vapor pressure isotope effect in the temperature region near 0°C, while Freons-13 and 14 are most likely to yield the inverse effect in the lower temperature region. (auth)

14847 TRITIUM FRACTIONATION ON THE CRYSTAL GROWTH OF SODIUM SULFATE DECAHYDRATE FROM ITS TRITIATED AQUEOUS SOLUTION. Tanaka, Haruhiko; Negita, Hisao (Hiroshima Univ.). Bull. Chem. Soc. Jap.; 44: No. 8, 2075-7(Aug 1971).

The fractionation of tritiated water (HTO) was examined during crystallization of sodium sulfate decahydrate, $Na_2SO_4 \cdot 10H_2O$, from a slightly supersaturated solution that contained a trace amount of tritium. No appreciable fractionation of HTO was found to occur in the crystallization under both stirred and unstirred conditions. The factors that may influence the degree of the fractionation were generally considered in connection with studies by deuterated water. Virtually all of the water of crystallization in sodium sulfate decahydrate should come from free water in its aqueous solution, and should integrate into the crystal in accordance with the volume-diffusion model. This model was supported also by the energetical consideration of the sodium ion in the crystallization. (auth)

14848 ISOTOPE SEPARATION FACTOR IN EQUILIBRIUM PROCESSES. Panchenkov, G. M.; Basov, Yu. G. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 6, 862-3(Jun 1971).

Translated from Zh. Fiz. Khim.; 45: No. 6, 1529-30(Jun 1971).

Formulas for the separation factors in equilibrium processes have been derived on the basis of the chemical collision theory. (auth)

14849 HYDROGEN ISOTOPIC EXCHANGES T–H, T–D, D–H, AND H–D BETWEEN DIAZOACETONE AND DIAZOACETALDEHYDE. SPEED OF PROTONATION AND ISOTOPIC EFFECTS. Dahn, H.; Malherbe, R.; Beaud, P. (Univ., Lausanne, Switzerland). Helv. Chim. Acta; 54: No. 7, 2202-5(1971). (In French).

The velocities of four acid-catalyzed hydrogen isotope exchange reactions between diazoacetone (1) and water (T → H, T → D, D → H, and H → D) and of three exchange reactions between diazoacetaldehyde (2) and water (T → H, T → D, and H → D) were measured. The exchange D → H of 1 was found to submit to general acid catalysis ($\alpha_B = 0.6$). The rates of protonation of primary and secondary diazocarbonyl compounds of similar structure were found to be quite similar, in spite of the difference in mechanism (A-2 and A-S_E2, respectively). (auth)

14850 STUDY OF THE KINETICS OF ISOTOPIC EXCHANGE IN THE SYSTEM $(C_6H_5)_2Te$–$(C_6H_5)_2TeX_2$–$CHCl_3$ FOR VARIOUS HALO DERIVATIVES. Nefedov, V. D.; Sinotova, E. N.; Sarbash, A. N.; Kolobov, E. A.; Kapustin, V. K. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 450-3(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 435-9(May-Jun 1971).

The kinetics of isotopic exchange were studied in the systems $(C_6H_5)_2Te$–$(C_6H_5)_2TeX_2$–$CHCl_3$, where X is a halogen atom. The degree of freedom was determined as a function of time, concentrations of the exchanging compounds and temperature. Data are presented in graphs. The rate of ^{127}Te exchange between diphenyltellurium and diphenyltellurium dihalide increased sharply as other halo derivatives were used instead of fluorides and was accompanied by a change in the order of the isotopic exchange reaction. (M.C.G.)

14851 QUANTUM-STATISTICAL ESTIMATION OF ISOTOPE EFFECT IN LIQUID EXCHANGER-SOLUTION SYSTEM. Tikhomirov, I. A.; Larionov, V. V.; Vergun, A. P.; Doronin, V. T. (Tomsk Polytechnic Inst., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 7, 1024-5(Jul 1971).

Translated from Zh. Fiz. Khim.; 45: No. 7, 1805(Jul 1971).

The choice of methods is discussed for a directed search for liquid exchanger–solution systems having a maximum single-stage isotope separation factor. For this purpose the β-factors of isotopic exchanger molecules were calculated empirically. This enabled the effect of the concentration and nature of the solvent on the magnitude of the isotope effect to be elucidated. The β-factors of $D2EGF^-M^+$ molecules lie in the range 1.03 to 1.04. (auth)

14852 ISOTOPE EFFECT IN THE ELECTRON BOMBARDMENT OF SULPHUR DIOXIDE MOLECULES. Ustinov, V. I.; Grinenko, V. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 7, 935-7(Jul 1971).

Translated from Zh. Fiz. Khim.; 45: No. 7, 1653-6(Jul 1971).

The results of the fractionation of oxygen isotopes in the dissociation of sulfur dioxide by electron impact in a mass spectrometer are presented. The separation factor α was determined from the ratios of the ionic current with M/e = 48, 50, 64, and 66 for SO_2 having the natural isotope content and SO_2 enriched in the oxygen-18 isotope to 15%. Comparison of the experimental value $\alpha_e = 1.046$ with the theoretical separation factor (the calculations were performed by two different methods) shows satisfactory agreement. (auth)

14853 RADIOACTIVITY OF CERTAIN STABLE ISOTOPE-ENRICHED SUBSTANCES. Jordan, P.; May, K. (Eidgenoessiche Technische Hochschule, Zurich. Univ., Zurich). Experientia; 27: No. 10, 1146-7(15 Oct 1971).

Measurements of the radioactivity of numerous samples of heavy water and deuterated substances of varied diverse origins have shown that substances with a high content of deuterium (>99%) have a specific radioactivity of the order of 5 μCi/g of deuterium, due to the tritium of natural origin concentrated at the same time as the deuterium. The phenomenon is not limited to the isotopes of hydrogen. It is of general character and has important theoretical and practical consequences. (auth)

14854 ISOTOPE EFFECTS IN PROTON-TRANSFER REACTIONS. III. DETERMINATION OF THE EQUILIBRIUM CONSTANT FOR THE PROTIUM–DEUTERIUM EXCHANGE BETWEEN 2-METHYL-3-PHENYLPROPIONITRILE AND METHANOL. Bergman, Nils-Aake (Univ. of Goteborg). Acta Chem. Scand.; 25: 1517-19(1971).

By equilibrating 2-methyl-3-phenylpropionitrile with a mixture of ordinary and heavy methanol using sodium methoxide as a catalyst it should be possible to determine the ratio $K_H/K_D = K$, where K is the equilibrium constant for the exchange equilibrium $C_6H_5CH_2CH(CH_3)CN + DOCH_3 \rightleftharpoons C_6H_5CH_2CD(CH_3)CN + HOCH_3$. The results obtained from the equilibrium measurements indicate that a reasonable value for K in ordinary methanol would lie around 1.2. (Denmark)

14855 HYDROGEN–DEUTERIUM EXCHANGE OF AMIDE GROUPS INCORPORATED INTO POLYMERIC SYSTEMS. Miller, Michael Stephen. Evanston, Ill.; Northwestern Univ. (1971). 111p. University Microfilms Order No. 71-30,893.

Thesis.

Hydrogen isotope exchange of peptide protons was used to probe the structures of proteins in solution. The assumption is usually made that hydrogen bonding, especially in helical segments, slows isotope exchange relative to the rate for random coil polypeptide segments. Evidence has been accumulated indicating this assumption is too restrictive. A macromolecular environment has been found to be sufficient to slow isotope exchange in poly(N-isopropylacrylamide) in D_2O. This exchange was monitored in the near infrared where overtones of fundamental OH and free and bonded NH stretches were observed. The rate constants obtained from absorbance changes of all three bands are identical. Like other previously examined amides, the polymer undergoes acid and base catalysis of isotope exchange with the rate constant passing through a minimum, k_{min}, at a characteristic pD, pD_{min}. The k_{min} for poly(N-isopropylacrylamide) is sixty times less than that of a low molecular weight analog, N-isopropylpropionamide. This diminution in rate could not be attributed to the presence of a pre-equilibrium between free and bonded amide groups; it may arise from steric effects or perturbations in the properties of the solvent in the vicinity of the amide group. In this study the effects of structural changes made in the pendant amide group and along the polymeric backbone on the rate of H–D exchange in D_2O were determined. The compounds studied were poly(N-ethylacrylamide), poly(N-ethylmethacrylamide), and their low molecular weight analogs, N-ethylpropionamide and N-ethylisobutyramide. As shown in their near infrared spectra in D_2O, both polymers possess free and bonded amide groups. Like poly(N-isopropylacrylamide), they exchange their protons with values of k_{min} lower than the small amides. Potential causes for the decrease in rate are the same as stated for poly(N-isopropylacrylamide). The relative values of k_{min} for the polymers demonstrated that the "intrinsic" reactivity of the amide groups does not change a great deal from the small amides to the polymers. The ratio of k_{min} for poly(N-ethylacrylamide) and poly(N-isopropylacrylamide) is 3.2 as compared to the analogous ratio of 2.2 for the small related amides. Similarly, the same ratio for poly(N-ethylacrylamide) and poly(N-ethylmethacrylamide) is 4.4 as compared to 2.2 for the small amides. The differences in the ratios for the poiymers may arise from the greater apolar character of poly(N-ethylmethacrylamide) relative to poly(N-isopropylacrylamide) and/or from greater steric interactions in poly(N-ethylmethacrylamide) as compared to poly(N-isopropylacrylamide). The effect of backbone substitution in poly(N-ethylmethacrylamide) is most interesting. The polymer has a pD_{min} 0.75 units higher than the other two polymers which both possess a pD_{min} of 5.0. Space filling models of poly(N-ethylmethacrylamide) predict a rigid structure in which several amide groups deviate slightly from planarity. This would favor the amide resonance form possessing a single C–N bond, a species favoring acid relative to base catalysis. This is in agreement with the shift in pD_{min} to higher values. This work has served to demonstrate structural effects on H–D exchange in polymers. Information such as this will contribute to an understanding of parameters affecting isotope exchange in proteins. (Diss. Abstr. Int., B)

14856 METHOD OF INCREASING THE CONCENTRATION OF ^{18}O IN AN OXYGEN-CONTAINING COMPOUND. Johnson, Everett R.; Ladov, Edwin N.; Holtzscheiter, Earl W. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,622,480. 23 Nov 1971. Filed 4 Nov 1969.

A method of producing oxygen-18-enriched compounds comprises irradiating a compound containing an oxygen-containing anion with high energy radiation in the presence of a gas containing ^{18}O. (auth)

14857 METHOD OF PRODUCING COMPOUNDS ENRICHED IN ^{18}O. Johnson, Everett R.; Ladov, Edwin N. (to United States Atomic Energy Commission). U. S. Patent 3,622,481. 23 Nov 1971. Filed 4 Nov 1969.

A method is presented for increasing the ^{18}O concentration in a compound containing oxygen and nitrogen by irradiating KNO_3 with high-energy radiation until at least 10 mole percent of the KNO_3 is decomposed into KNO_2 and oxygen and separating the resulting ^{18}O-enriched KNO_2 from the KNO_3. (auth)

14858 TEMPERATURE DEPENDENCE AND TIME VARIATION OF SEPARATION FACTORS IN ISOTOPE FRACTIONATION BY ELECTROMIGRATION IN MOLTEN SALTS. Kanno,

Hitoshi (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: No. 12, 725-7(Dec 1971).

The temperature dependence of the overall separation factor at steady state of electromigration and the time variation in the overall separation factor at the anode in the earlier stages are discussed. The overall separation factor at steady state decreases exponentially with rise in operating temperature and the overall separation factor increases exponentially with the progress of electromigration at constant current density. (M.C.G.)

14859 KINETIC STUDY OF THE ACETATE-CATALYZED ALDOL REACTION BETWEEN CHLORAL AND ALKYL METHYL KETONES. Menon, B. C.; Kiehlmann, Eberhard (Simon Fraser Univ., Burnaby, B. C.). Can. J. Chem.; 49: No. 22, 3648-52 (15 Nov 1971).

A kinetic study of the acetate-catalyzed crossed aldol reaction of chloral with butanone, 2-heptanone, and 4-methyl-2-pentanone, respectively, in glacial acetic acid at 60° was carried out. A comparison of the condensation rates with those for the acetate-catalyzed deuterium exchange of the ketones in glacial acetic acid at 60° indicates that the carbon–carbon bond formation in the aldol reaction is the rate-determining step. The relative rate constants for the crossed aldol reaction and the deuterium exchange of the corresponding ketones are best interpreted in terms of steric rather than polar effects. (auth)

Feed Materials Processing

Refer also to abstract 15035.

14860 (DOCKET-408027-5) SEQUOYAH URANIUM HEXAFLUORIDE PRODUCTION PLANT. Additional Information Regarding "Show Cause" Statement of November 1971. (Kerr-McGee Corp., Oklahoma City, Okla.). 21 Jan 1972. 3p Dep. NTIS.

Fluoride contents of samples of dry forage grasses around the plant are reported. Off gas from the NDX absorber was studied. Run off of fertilizers caused the anomalous nitrate content of wells. (M.C.G.)

14861 (DOCKET-408027-6) SEQUOYAH URANIUM HEXAFLUORIDE PRODUCTION PLANT. Supplemental Data for the Show Cause Statement. (Kerr-McGee Corp., Oklahoma City, Okla.). 31 Jan 1972. 6p. Dep. NTIS.

Vegetation samples were analyzed for fluoride content and NO_2 effluent was calculated. (M.C.G.)

14862 STUDY IN REDUCTION OF URANIUM IN LEACH LIQUORS OBTAINED FROM URANIUM ORES OF UMRA AND POKHRI-TUNJI PROSPECTS WITH NASCENT HYDROGEN. Ramachar, T. M. (Atomic Energy Division, New Delhi). Proc. Indian Nat. Sci. Acad., Part A; 37: No. 1, 77-81(Jan 1971). (CONF-681088-12).

From Symposium on the geology and mineralogy of atomic mineral deposits and their development for use in the nuclear power program; New Delhi, India (14 Oct 1968).

Normally, leach liquors obtained during the extraction of uranium are enriched by resin ion exchange followed by elution prior to precipitation of the uranium. Production of a crude cake by reduction of the leach liquor with nascent hydrogen produced by use of scrap iron is suggested as an alternative procedure. Results obtained in certain tests carried out on uranium ore samples using this procedure show that while 92.50 to 96% U_3O_8 in the liquor was precipitated in the case of the Umra ore, only 34.5 to 61.50% U_3O_8 was precipitated from the Pokhri-Tunji ore. The reactions and controls involved in this procedure are discussed. It is further suggested that single-stage reduction of uranium in leach liquor enables elimination of the three steps involved in the conventional method. (auth)

14863 PROCESS OF SEPARATING YTTRIUM FROM LANTHANIDE RARE EARTHS. Mason, George W.; Lewey, Sonia; Bollmeier, Allen F.; Peppard, Donald F. (to United States Atomic Energy Commission). U. S. Patent 3,615,171. 26 Oct 1971. Filed 15 Jun 1970.

Yttrium values are separated from lanthanide rare earth values that are present together as bromides in an aqueous feed solution containing excess bromide ions by extracting the lanthanide rare earth values and some of the yttrium values from the feed solution with bis(2-ethylhexyl) chloromethylphosphonate, scrubbing the yttrium values from the extractant with an aqueous scrub solution of hydrogen bromide and lithium bromide, and separating the yttrium values from the aqueous feed and scrub solutions. (auth)

14864 EXTRACTION OF URANIUM FROM THE BAGHALCHORE. Toor, F. D.; Chaudhry, M. N.; Shad, M. I.; Khan, M. H. (Atomic Energy Centre, Lahore). Nucleus (Karachi); 8: No. 3, 95-101(Jul-Sep 1971).

The inaccessibility of the uranium ore site at Baghalchore, the Dera Ghazi Khan district and the relatively dilute nature of the ore necessitates the formation of crude uranates that may be subsequently treated in a laboratory to yield a nuclear-grade product. The results of H_2SO_4 leaching of the ore show that, using air under pressure as an oxidizing agent, extraction efficiencies of up to 90% are achieved after 5 to 6 hr of leaching provided that sufficient H_2SO_4 was used to give a pH of 0.5 to 1.0 after leaching. The leaching time is reduced to 2 hr if the air oxidation is supplemented with HNO_3 or KNO_3. The leaching efficiency decreases if the pH of the leach solution is greater than 1.0, the H_2SO_4 is not pre-mixed with the ore, or the leaching time is less than that specified. Overall efficiencies of up to 60 to 70% are obtainable and can be further improved by reducing the uranium losses during lime precipitation. The crude cakes formed show up to a 100 times reduction in the bulk of the solids and an equivalent upgrading in the uranium contents, thus reducing considerably the bulk of solids to be transported from the ore site. (auth)

14865 RECOVERY OF URANIUM FROM NATURAL MINE WATERS BY COUNTERCURRENT ION EXCHANGE. Ross, J. R.; George, D. R. Rep. Invest. No. 7471. Washington, D. C.; Bureau of Mines (1971). 17p.

The U recoveries averaged in excess of 98% at solution flows ranging from 15 to 25 gal/ft^2/min and resin loadings up to 3.6 lb of U_3O_8/ft^3. In subsequent tests, loaded resin was continuously eluted in a countercurrent elution column with a diameter of 4 in. and containing a bed of resin 9 ft deep. Compared with existing ion-exchange practices for recovering U from mine waters, use of these improved ion-exchange contactors would reduce ion-exchange resin requirements at least 70% and allow further substantial reductions in capital and operating costs. (Metals Abstr.)

Radiation Chemistry

Refer also to abstracts 14801, 14856, 14983, 14992–14994, 14996, 15410, 16759, and 16767.

14866 (AEC-tr-7177) SOLVATED ELECTRON IN RADIATION CHEMISTRY. Pikaev, A. K. Translation of Sol'vatirovannyi Elektron v Radiatsionnoi Khimii, Izdatel'stvo Nauka, Moscow, 1969. 387p. (TT-70-50157; IPST-Cat.-5848). Dep. NTIS.

The importance of solvated electrons in the radiolysis of numerous systems is considered. The properties of solvated electrons, the theoretical aspects of electron trapping by polar media, the mechanism and special features of radiation-chemical reactions involving these particles are discussed. Reactions of these solvated electrons in radiolysis of ammonia, amines, amides, alcohols, ethers, and hydrocarbons are described. (M.C.G.)

14867 (CONF-680423) SECOND INTER-AMERICAN CONFERENCE ON RADIOCHEMISTRY, MEXICO CITY, MEXICO, APRIL 22–25, 1968. (Comision Interamericana de Energia Nuclear). 1971. 330p. (In several languages). Organizacion de los Estados Americanos, Washington, D. C. $3.00.

Separate abstracts were prepared for twenty-eight of the thirty-eight papers presented. Four papers appeared previously as NSA 22: 17741, 22: 27743, 24: 2149, and 24: 11734. (D.H.M.)

For abstracts of individual papers see: 14656–14658, 14704, 14768, 14842–14845, 14868–14873, 14980, 14983–14985, 15000, 15001, 15043–15045, 15243, 15347, 15385, and 16763.

14868 (CONF-680423–, pp 3-9) RADIATION CHEMISTRY IN URUGUAY. Gruenhut, Enrique (Universidad de la Republica, Montevideo (Uruguay). Facultad de Quimica). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The excitation, ionization, and recombination reactions induced by radiations are briefly reviewed as an introduction to the study of radiation chemistry in Uruguay. (J.S.R.)

14869 (CONF-680423–, pp 75-88) SOME ASPECTS OF RADIATION CHEMISTRY. Behrens, Harold (Chile Univ., Santiago. Laboratorio de Radioquimica). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

A bibliographic review is presented of the reactions following irradiation of matter. Only the interactions of radiation of low LET are considered. 53 references. (J.S.R.)

14870 (CONF-680423–, pp 89-101) CHEMICAL EFFECTS AND DAMAGE PRODUCED BY IONIZING RADIATION. Haissinsky, M. (Paris Univ. (France). Laboratoire Curie).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

Radiation chemistry is discussed in the following areas: (1) radiation damage in solids (mechanical and electrical properties, optical properties, thermal effects, and structural and chemical effects); (2) chemical effects on gases; (3) radiolysis of water and of aqueous solutions (primary yields, reaction rate constants with respect to concentration, pH, LET, dose rate, physical state, isotopic effect, and oxygen effect); and (4) radiolysis of organic solvents and compounds. (D.H.M.)

14871 (CONF-680423–, pp 102-15) DEAMINATION OF ORGANIC COMPOUNDS BY THE EFFECT OF IONIZING RADIATIONS. I. DEAMINATION OF L-PROLINE. II. DEAMINATION OF PYRROLE. Munoz, R. A.; Izurieta L., H. (Escuela Politecnica Nacional, Quito (Ecuador). Laboratorio de Investigaciones Aplicadas). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The deamination of L-proline and pyrrole by γ radiation and by oxidants were studied experimentally. The results showed that both compounds are deaminated by radiation and by the action of the oxidants hydrogen periodate and hydrogen peroxide. These results suggest that the deamination in both cases is very important to the interpretation of the mechanism in biological systems. The probable steps in the deamination are outlined. (J.S.R.)

14872 (CONF-680423–, pp 116-25) RADIOLYSIS OF SALTS OF THE OXY-ANIONS. Maddock, A. G. (State Univ. of New York, Buffalo).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

Methods used for studying the radiolysis of oxy-anions are reviewed. In one, the radiolysis products are identified and estimated in situ by such methods as spectrophotometry, electron spin resonance spectroscopy, infrared spectroscopy, Moessbauer spectroscopy, and others. The second approach is to try to identify and estimate the species present in the crystals by the reactions on solution of the crystals. Another approach to the problem, that of trying to predict what can be expected to happen in these systems in terms of theoretical models of the structure and properties of such solids, is also explored. (D.H.M.)

14873 (CONF-680423–, pp 126-34) RADIOLYSIS OF PETROLEUM PRODUCTS. Lujan, Javier Reyes (Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Fisica. Comision Nacional de Energia Nuclear, Mexico City). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The radiolytic yield of the gases (G value) in the radiolysis with ^{60}Co γ rays and 19-MeV electrons in the interval from 25 to 60°C was studied in representative samples of the heavy fractions of petroleum (such as the commercial lubricant bases and the refining residues) and in crude natural petroleum. The product gases were identified and the G values determined in the dose interval from 1 to 80 Mrad. (tr-auth)

14874 (JAERI–5027) ANNUAL REPORT NO. 4 OF OSAKA LABORATORY FOR RADIATION CHEMISTRY, APRIL 1, 1970–MARCH 31, 1971. (Japan Atomic Energy Research Inst., Tokyo). Oct 1971. 163p. (In Japanese and English). Dep. NTIS (U. S. Sales Only).

Separate abstracts have been prepared for 13 studies. The remaining investigation dealt with flash photoconductivity of chloranyl and pyromellitic dianhydride in solutions. (J.G.B.)

For abstracts of individual sections see: 14875–14887.

14875 (JAERI–5027, pp 6-15) RADIATION-INDUCED EMULSION POLYMERIZATION OF VINYL MONOMERS IN ORGANIC LIQUIDS. Kitajima, Masahiko; Hayashi, Kanae; Okamura, Seizo (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

Preparation of polymer organo sols (dispersed polymers) in organic liquids, was attempted in systems of vinyl monomer solutions using γ-radiation as well as radical initiators. Stable polymer organo sols were not formed by the chemical method but were successfully formed by the radiation-chemical method using poly(acrylic acid) (PAA), which acted as a dispersion agent after irradiation in alcohols. In aliphatic hydrocarbons, ethylene–vinyl acetate copolymer was found to be a good dispersion agent for both methods. The polymerization mechanism of styrene in the PAA–methanol system by radiation was investigated in some detail. At the initial step of polymerization, graft copolymerization of styrene onto PAA as well as homopolymerization of styrene took place in methanol solution. The graft copolymer thus formed appears to serve as a dispersion agent of polystyrene in methanol medium to form particles of styrene and polystyrene. At the later step, the polymerization proceeded predominantly in the particles as is common in the emulsion polymerization in aqueous systems. (auth)

14876 (JAERI–5027, pp 16-21) RADIATION-INDUCED SCISSION OF CELLULOSE MOLECULES. Sakurada, Ichiro; Okada, Toshio; Kaji, Kanako (Japan Atomic Energy Research Inst., Tokyo).

Radioinduced depolymerization of various types of cellulose, including polynosics, high-tenacity rayon, cupra rayon, and Texas and Egyptian cotton, was studied by viscosity measurement. Irradiation was performed with γ-rays from a ^{60}Co source in both air and in vacuo. The number of scissions of chemical bonds of cellulose molecules by the irradiation was calculated and found to be practically independent of the nature, degree of polymerization, and microstructure of the initial cellulose. The presence of air at the time of irradiation has also no strong effect on the degradation of cellulose. The number of scissions is not directly proportional to irradiation dose, and the G value of scission of cellulose decreases with increasing dose. (auth)

14877 (JAERI–5027, pp 22-5) RADIATION EFFECT ON THE MECHANICAL PROPERTIES OF CELLULOSE FIBERS. Sakurada, Ichiro; Okada, Toshio (Japan Atomic Energy Research Inst., Tokyo).

Four types of cellulose fibers including polynosics, high-tenacity rayon, Texas and Egyptian cottom were irradiated with γ rays (0.6 to 12 Mrad) in air and in vacuo to study the effect of radiation on the mechanical properties of the fibers. Mechanical properties of single fibers were measured. As in the case of scission of molecules, the presence of air at the irradiation has only a small effect on the change of mechanical properties. Percent loss of conditioned and wet strength are practically independent of the kind of cellulose fibers. The change of the initial elastic moduli of fibers by the irradiation is negligible. (auth)

14878 (JAERI–5027, pp 26-31) RADIATION CROSS-LINKING OF NYLONS. Kaji, Kanako; Okada, Toshio; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

Cross-linking induced by γ irradiation was studied on monofilaments of nylon 6, 610, and 12 at room temperature, and 100°C, which is a temperature above the glass-transition points of the three nylons. Viscometric studies showed that degradation predominated in all nylon samples when the irradiation was carried out in air, whereas cross-linking took place predominantly in the case of irradiation in vacuo, irrespective of irradiation temperature. Cross-linking was investigated further by gel formation by irradiation. From gel–dose curves it was found that gel was formed more easily at 100°C than at room temperature. The G-values for the cross-linking and the main-chain scission of the samples irradiated in vacuo were calculated by Charlesby-Pinner plots. The cross-linking G-values of nylons were nearly the same as that of polyethylene, whereas the G-values of scission were much larger than that of polyethylene. This is the reason nylon requires a very large incipient dose to form gel by irradiation. G-values of cross-linking of nylons increased with the number of methylene groups between the amide groups. (auth)

14879 (JAERI–5027, pp 32-4) SPINNING OF POLYVINYL CHLORIDE–POLYACRYLONITRILE BLEND. Okada, Toshio; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

Poly(vinyl chloride) and polyacrylonitrile are essentially incompatible, however it was found that, after strong stirring with dimethylformamide, clear dope suitable for spinning might be obtained after selection of molecular weights of the polymers, blending ratio, concentration, and dissolving temperature. The spinning was carried out using a wet process. The properties of the fiber thus obtained were quite similar to those of fibers prepared by fiber-grafting or spinning of the reaction product of powder-grafting. Polyacrylonitrile was prepared using a γ-irradiation method. (auth)

14880 (JAERI–5027, pp 35-41) EFFECT OF GRAFT REACTION PRODUCTS OF POLYVINYL CHLORIDE AND ACRYLONITRILE ON THE COMPATIBILITY OF THE BLEND OF ITS COMPONENT HOMOPOLYMERS. Yamazaki, Kaoru; Okada, Toshio; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

The compatibility of polyacrylonitrile with poly(vinyl chloride) in dimethylformamide solution and the effects of graft reaction products on the compatibility were studied. Commercial poly(vinyl chloride) was used; polyacrylonitriles with different molecular weights were prepared by a radiation-chemical method using γ rays and a conventional catalytic method using a redox catalyst such as ammonium persulfate and sodium bisulfate. Graft reac-

tions were carried out also by radiation-chemical and catalytic methods. When the compatibility was poor, phase separation was observed. The graft reaction product is apparently more stable than a blend of poly(vinyl chloride) and polyacrylonitrile, although it contains a very small amount of the true graft copolymer. The higher the degree of polymerization, the longer the time required for phase separation. The higher the concentration of the blend, the longer the time required for phase separation. The lower the temperature, the longer the time required for phase separation. The critical concentration of compatibility is ca 2% for the blend of poly(vinyl chloride) ($\bar{P}$ = 980) and polyacrylonitrile ($\bar{P}$ = 2520) (1 : 1, by weight) in dimethylformamide at 70°C. An addition of a small amount (ca 6%) of grafting reaction products to the polyblend brings about a remarkable improvement in the retardation of phase separation. (auth)

14881 (JAERI–5027, pp 42–9) RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYESTER. IX. COMPARISON OF ACRYLIC ACID GRAFT POLYETHYLENE TEREPHTHALATE FIBERS PREPARED BY IRRADIATION AT ELEVATED AND ROOM TEMPERATURE. Shimano, Yasunao; Okada, Toshio; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

Acrylic acid- and sodium acrylate-graft polyester fabrics prepared by irradiation at 100°C and room temperature were investigated with respect to hygroscopic, frictional electric, and dyeing properties. Hygroscopic and frictional electric properties of polyester fabrics were improved to some extent by the grafting of acrylic acid, but the values were much lower than those of cotton fabric. Conversion to the sodium salt of acrylic acid grafts enhanced remarkably both the properties. For example, sodium salt grafts of 3 to 5% showed nearly the same frictional electricity as that of cotton fabrics when measured by a rotary static tester at 40% R. H. and 25°C. Irradiation temperature at the time of grafting did not affect the hygroscopic and frictional electric properties of the grafts. On the other hand, the graft fabric prepared by irradiation at room temperature exhibited undesirable dyeing properties compared with those of the grafts prepared by irradiation at CA 100°C. The reason of these undesirable dyeing properties was revealed by microscopic and scanning electron microscopic investigations. In the case of the reaction at room temperature, the polymerization of acrylic acid took place mainly on the surface of fibers or at the space between fibers, whereas at 100°C the polymerization took place inside fibers, that is, in the fiber matrix. Both electron beam and γ irradiation were used. (auth)

14882 (JAERI–5027, pp 50–62) RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYESTER. X. GRAFTING OF ACRYLIC ACID ONTO DRAWN POLYETHYLENE TEREPHTHALATE FIBER WITH IMMERSION METHOD IN THE PRESENCE OF MOHR'S SALT. Okada, Toshio; Kaji, Kanako; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

Radiation grafting of acrylic acid onto drawn polyester fiber was studied in aqueous solution in the presence of salts of metals such as Mohr's salt. Most experiments were carried out with a direct irradiation immersion technique using γ rays from a ^{60}Co source. For comparison, some of experiments were performed with an impregnation technique using electron beams from a Van de Graaff accelerator. The rates of grafting and homopolymerization of acrylic acid were decreased by salts such as Mohr's salt, cupric sulfate, and cuprous chloride. In the absence of these salts, gel formation proceeded very rapidly and prevented separation of graft fiber from gelled homopolymer. Although the rate of grafting was reduced with these salts, the grafting proceeded very smoothly at an appreciable rate and the graft fiber could easily be separated from the solution. A study was made of the kinetics of grafting in the presence of Mohr's salt over a temperature range of 18 to 90°C. The rate of grafting was greatly dependent on the concentration of monomer in aqueous solution. A very small amount of grafting was observed when the monomer concentration was less than 20%. Above 70% the retarding effect of Mohr's salt was so weak that gel formation in aqueous solution was not suppressed. The rate of apparent grafting at 5% graft was proportional to the 0.75th power of the dose rate over the range from 6.5×10^3 rad/hr (γ rays) to 1.8×10^5 rad/hr (V. d. G. electron beams). The apparent overall activation energy for the grafting was determined to be 8 kcal/mole between 18 and 40°C and 1.4 kcal/mole between 50 and 90°C, respectively. The rate of homopolymerization as well as molecular weight of polymer formed were decreased by an addition of Mohr's salt. The graft polyester fibers which had been prepared with irradiation at room temperature could be dyed homogeneously and as deeply as those of the graft fiber obtained by irradiation at a temperature above 60°C. Microscopic cross-sectional observation of the dyed fibers revealed that polymerized acrylic acid was located either in the inside-periphery of the fiber or penetrated through the whole inside of the fiber. Tests have shown that no metal salts other than those of iron or copper have substantially retarding effects but in some cases they show initiating or accelerating effects on the polymerization in the following order of effectiveness: $Cu^{+} > Cu^{2+} > Fe^{2+}$. Conventional inhibiting organic agents, such as hydroquinone, were not suitable for the grafting of acrylic acid. (auth)

14883 (JAERI–5027, pp 63–71) PREPARATION OF WOOD–POLYMER COMPOSITE BY IONIZING RADIATION. VII. IMPROVEMENT OF THERMAL STABILITY OF VINYLIDENE CHLORIDE COPOLYMERS AND FIRE RETARDANCY OF THE WOOD–VINYLIDENE CHLORIDE COPOLYMER COMPOSITES. Gotoda, Masao; Takeshita, Noboru (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

For the purpose of preparing fire-retardant poly(vinylidene chloride) (PVDC)-based wood–polymer composites (WPC) with low polymer loading, the effects of copolymerization of VDC with suitable comonomers were studied. Gamma-induced copolymerization of VDC with other monomers was studied for preparing thermally stable copolymers, which give fire-retardant WPC when combined with wood. Mixtures of VDC–acrylonitrile (8 : 2), containing more than 10% triallyl phosphate (TAP) and VDC–TAP (8 : 2), gave thermally stable copolymers. WPC's were also prepared from these monomer mixtures and found to have a good fire retardancy, despite their rather smaller polymer loading (i.e., less than ca 30%), and also good thermal stability. (auth)

14884 (JAERI–5027, pp 72–81) PREPARATION OF WOOD–POLYMER COMPOSITE BY IONIZING RADIATION. VIII. RADIATION CURING OF MONOMER SOLUTION OF CHLORINATED ALLYL CHLORIDE OLIGOMER AND ITS APPLICATION TO THE PREPARATION OF FLAME RETARDANT WOOD–POLYMER COMPOSITE. Gotoda, Masao; Takeshita, Noboru (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

The electron beam curing of mixtures of chlorinated allyl chloride oligomer (Cl-OAC)–monomer solution, impregnated in wood, was studied for the preparation of fire-retardant wood–polymer composite (WPC) sheets. The impregnation was found to be rather easy because the viscosity of these mixtures was low. Fire-retardant plastics can be prepared, from monomers containing P or N, or both elements and a crosslinking agent. An addition of $SbCl_3$ to these mixtures was also effective for fire retardancy. (auth)

14885 (JAERI–5027, pp 82–90) FIRE-RETARDANT WPC BASED ON RADIATION-INDUCED POLYMERIZATION OF PHOSPHORUS-CONTAINING VINYL MONOMERS PARTICULARLY BIS(2-CHLOROETHYL) VINYLPHOSPHONATE. Ahmed, Amin Uddin; Takeshita, Noboru; Gotoda, Masao (Japan Atomic Energy Research Inst., Tokyo).

Wood–plastic composites (WPC) based on bis(2-chloroethyl) vinylphosphonate (BCVP) and vinyl acetate (VA), as well as those based on BCVP and acrylonitrile (AN), showed excellent fire retardency and improvement in dimensional stability. The use of methyl methacrylate or vinylidene chloride or styrene as one of the monomers with BCVP did not give improvement in the dimensional stability of the WPC, though fire retardancy was good. The incorporation of vinylpyrrolidone resulted in poor dimensional stability of WPC. WPC based on dimethyldichlorovinyl phosphate (DDVP) or diethyl vinylphosphonate (DEVP) gave improvement in fire retardancy, but conversion of monomer to polymer was slight. The WPC based on the phosphate salt of dimethylaminoethyl methacrylate underwent tremendous swelling in water, though the fire retardancy was good. (auth)

14886 (JAERI–5027, pp 91–9) RADIATION CURING OF MIXTURE OF DIALLYL PHTHALATE PREPOLYMER AND VINYL MONOMER. VI. APPLICATION OF ELECTRON BEAM CURING OF DIALLYL PHTHALATE PREPOLYMER/MONOMER MIXTURE TO THE PREPARATION OF WOOD POLYMER COMPOSITE PILED BOARD. Gotoda, Masao; Yokoyama, Kenji; Takeshita, Noboru; Senzaki, Yoshimichi (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

The preparation of plywood with thin wood–plastic composites (WPC) decorative laminate by a single process of electron beam irradiation of diallyl phthalate–monomer mixture impregnated in veneer pressed on substrate board (plywood or particle board) was investigated. The adherability of the WPC to the substrate and the resistance to abrasion and weathering were studied as to the resin composition. Results indicate that acrylonitrile gives good adherability, and butyl acrylate is very effective for improving abrasion resistance. For the improvement of weathering resistance of wood, it was found that addition of a hydrophilic monomer such as polyethylene glycol dimethacrylate to the resin

mixture is very effective and the coating over WPC is indispensable for this purpose. A small scale continuous electron beam irradiator was constructed. (auth)

14887 (JAERI-5027, pp 100-13) RADIATION CURING OF MIXTURE OF DIALLYL PHTHALATE PREPOLYMER AND VINYL MONOMER. VII. APPLICATION OF ELECTRON BEAM CURING OF DIALLYL PHTHALATE PREPOLYMER/MONOMER MIXTURE TO THE COATINGS ON ASBESTOS CEMENT SHEET. Gotoda, Masao; Yokoyama, Kenji; Kinuhara, Kazuo; Ohta, Masato (Japan Atomic Energy Research Inst., Tokyo).

Electron beam curable coatings applied to asbestos cement sheet were studied as to the coating compositions of diallyl phthalate (DAPp)-monomer (1 : 1) mixture. An accelerator and a pigment (TiO_2) were added. It was found that precoating of a sealer based on epoxy resin was very effective for the improvement of adherability of coating. Coating compositions of DAPp-acrylonitrile-accelerator and DAP-methyl acrylate-trimethylpropane trimethacrylate-accelerator with pigment gave superior coating performance. Although the coating from the former composition was discolored easily on heating or by ultraviolet radiation, it may be useful for creamy or dark colored ones. Performance of the coatings, cured in an atmosphere of N_2 or air, is somewhat inferior to the one supplied by a film overlay method, especially with regard to stain and solvent resistance. (auth)

14888 (NP-19097) CALCULATION OF PRODUCTIVITY AND OPTIMIZATION OF PARAMETERS OF CHEMONUCLEAR INSTALLATIONS. Dzantiev, B. G.; Krasin, A. K.; Nichipor, G. V.; Kazazyan, V. T.; Savushkin, I. A. (Akademiya Nauk Belorusskoi SSR, Minsk. Institut Yadernoi Energetiki). [1970]. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The economic evaluation indicators for a given radiation-chemical installation are tied chiefly to the productivity of that installation, i.e., tons of the desired product per year. An equation defining productivity in terms of other variables is taken from the literature and discussed. Paths of approximate solution are indicated where a precise analytical solution is not possible. The production of hydrazine in a nuclear reactor by the radiolysis of gaseous ammonia is discussed in terms of a stationary state process. Calculations are conducted for this chemonuclear reaction at pressures of 5 and 10 atmospheres, respectively, the temperatures of the duct at the input and exit points being 323°K and 473°K. The results show that such a process could produce 15,500 tons/yr of hydrazine at a G value of 2.3 moles/100 eV. The productivity of individual channels in the reactor would vary from 120 tons/yr at the center of the core to only 20 tons/yr at the core's edge. (K.S.W.)

14889 (NP-19162) EFFECTS OF NITROUS OXIDE AND ETHYLENE ON THE GAS YIELDS AND GEL FORMATION FROM γ-IRRADIATED POLYPROPYLENE. Report 418. Pinkerton, D. M. (Defence Standards Labs., Maribyrnong (Australia)). Oct 1971. 25p. Dep. NTIS (U. S. Sales Only).

Isotactic and atactic polypropylenes were γ-irradiated in a vacuum, in nitrous oxide, and in ethylene, and also in the presence of mixtures of these two gases. The γ-irradiation of the isotactic propylene in a vacuum gives a H_2 yield that is nonlinear with dose, whereas the CH_4 yield is linear with dose. Yields of H_2 and CH_4 from atactic polypropylene obey a linear relationship with the dose delivered. Both N_2O and ethylene depress the $G(H_2)$ obtained from vacuum irradiations of isotactic polypropylene, the former due to electron scavenging and the latter to hydrogen atom scavenging. The scavenger studies lead to $G(e^-) = 0.7 \pm 0.1$, $G(H)_{thermal} = 1.0 \pm 0.1$, and $G(H_2)_{molecular} = 1.86 \pm 0.05$. Compared to vacuum irradiations, N_2O enhances, and ethylene suppresses completely, the crosslinking yield in isotactic polypropylene. In equimolar mixtures of N_2O and ethylene the crosslinking yield is suppressed completely. It is suggested that N_2O enhances the crosslinking mechanism through an energy transfer and dehydrogenation process and that ethylene interferes by radial scavenging. In mixtures, the results are consistent with ethylene participating in the energy transfer reaction in preference to the N_2O and so inhibiting the additional crosslinking that N_2O causes through the dehydrogenation reaction. A tentative reaction sequence is proposed. (auth) (Australia)

14890 (NYO-3383-20) ROLE OF STRUCTURE AND ENERGY (OR IONIZATION) TRANSFER IN RADIATION CHEMISTRY AND BIOLOGY. Progress Report, March 22, 1967-June 8, 1971. Trumbore, C. N. (Delaware Univ., Newark. Dept. of Chemistry). Contract AT(30-1)-3383. 12p. Dep. NTIS.

14891 (NYO-4110) RADIATION CROSSLINKING OF POLYMERS WITH SEGREGATED METALLIC PARTICLES. Annual Report, June 1, 1969-May 31, 1970. Turner, D. T.; Malliaris, A.; Kusy, R. P. (Drexel Univ., Philadelphia, Pa. Dept. of Metallurgical Engineering). Jan 1972. Contract AT(30-1)-4110. 95p. Dep. NTIS.

Preliminary experiments showed that compaction of mixtures of poly(vinyl chloride) (PVC) and metallic powders provided materials that were good conductors of electricity and heat for surprisingly low volume percents of metal, e.g., 6% Ni or Cu. However, the materials formed in this manner have the disadvantage of poor resistance to heat distortion. Work was carried out to overcome this problem by radioinduced crosslinking of the polymer. Accordingly, attention was concentrated on polyethylene and nylon-66 since these are conveniently crosslinked by γ-irradiation. General conditions for attaining optimum electric conductivity and mechanical strength were investigated. A model that postulates that large spherical particles of polymer are covered with smaller particles of metal, and that this geometry is largely retained after compaction, succeeds in predicting the dependence of electric conductivity on the relative sizes of the particles. Evidence is presented that a considerable mechanical strength may be realized by the compaction technique. This falls short of values attained by conventional processing, but it is believed that this deficiency could be remedied by increased heating, which is expected to improve the coalescence of the particles of polymer. It is shown that γ-irradiation of compacts of nickel with either polyethylene or nylon-66 are improved in resistance to heat distortion through formation of a crosslinked network of polymer. However, there are two factors that limit application of radiation processing; a relatively high dose is required (at least 5 Mrad in the case of polyethylene and more in the case of nylon-66) and the process is limited to polymers that can be crosslinked by radiation. (M.C.G.)

14892 (ORNL-tr-2560) INITIATION OF CHEMICAL REACTIONS WITH ACCELERATOR ELECTRONS. Antonov, V. N.; Gorgonov, V. I.; Dzhagatspanyan, R. V.; Kon'kov, N. G.; Krutetskaya, O. N.; Lyaskin, Yu. G.; Osipov, V. B.; Panin, Yu. A. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Radiats. Tekh.; No. 6, 192-5(1971). 4p. Dep. NTIS.

Accelerators for use in the chemical industry are discussed. Calculations and experiments have shown how a high coefficient of electron use may be maintained with a decrease in chamber dimensions. A cylindrical reaction chamber may be used with a solenoid winding along all the whole height of the heated surface. Experimental work was carried out on purification of chlorine using and electron accelerator. (M.C.G.)

14893 (TID-25885) LOW-ENERGY ELECTRON BOMBARDMENT OF THIN FILMS OF n-PENTANE AT 77°K. (Florida State Univ., Tallahassee). [1970]. Contract AT(40-1)-2001. 5p. Dep. NTIS.

Chemical effects of low-energy electron bombardment of thin films of n-pentane at 77°K are being studied. At 100 and 40 eV, four to six products were formed after irradiation. (M.C.G.)

14894 CNDO/2 CALCULATION ON THE RADICAL FORMED ON ELECTRON IRRADIATION OF MESITYLENE. Fantechi, R.; Helche, G. A. (EURATOM-CCR, Ispra, Italy). Mol. Phys.; 22: No. 4, 737-40(1971).

The results obtained by the CNDO/2 molecular orbital method of the radical formed on electron irradiation of mesitylene adsorbed in the cavities of a zeolite matrix are given. These results support the original assignment of the spectrum, obtained by an ESR study, to the 1,3,5-trimethylcyclohexadienyl radical. (UK)

14895 EFFECT OF γ-IRRADIATION ON THE OXIDATION STATE OF MANGANESE IN POTASSIUM PERMANGANATE. Swordsma, Henry B.; Tumosa, Charles S.; Ache, Hans J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Radiochim. Acta; 16: No. 2, 112-14(Nov 1971).

It was confirmed that, at a neutron flux of 10^{12} n/cm² sec and an exposure time of 2 min at 40°C, in the irradiation of ^{54}Mn-labeled $KMnO_4$, only negligible if any decomposition occurred because of radiolysis or chemical treatment, which resulted in a change of the oxidation state of the manganese in $KMnO_4$. Gamma irradiation of the ^{54}Mn-labeled $KMnO_4$ was carried out at dose rates of 1.5 Megarad/hr up to doses of 1000 Megarads. At γ doses of ≤500 Megarads a maximum conversion of Mn^{7+} to Mn^{2+} of about 4% was observed, which increased to 7% at 1000 Megarads. It was concluded that only those few events in which Compton electrons or photoelectrons are able to displace the manganese atom directly from its original lattice position result in changes in its oxidation state. (M.C.G.)

14896 ACRYLONITRILE-GRAFTED PA 6 THREADS. Molnar, I. Magy. Textiltech.; 22: No. 11, 604-5(1970). (In Hungarian).

Grafting was initiated with a 500-Ci ^{60}Co radiation source having 200 krad/hr dose performance in its useful radiation space. Grafting of 6% AN(acrylonitrile) on the PA 6 threads brings about 6 to 10% longitudinal shrinkage without change in moisture uptake. Grafted threads swell by about 2% in AN–methanol–water mixture. No swelling could be observed after soaking in the individual components. After 200 hr exposure to light under Xenotest lamps no change was found in the tensile strength of the threads. A radiation dose of 0.5 Mrad did not affect the tensile strength of grafted threads while their untreated parallels lose 5% of their tensile strength when exposed to the same conditions. Alkaline boiling causes less damage to the grafted threads but induces a yellow discoloration, which can be made to disappear by boiling in acid. Under heat treatment untreated threads melt at 211°C whereas grafted threads only char at 250°C without losing their thread character. (Hung. Tech. Abstr.)

14897 HIGH-PRESSURE RADIOLYTIC OXIDATION OF CYCLOHEXANE. Case, Forrest N.; Smiley, David E.; Kau, Donald L. (to United States Atomic Energy Commission). U. S. Patent 3,616,378. 26 Oct 1971. Filed 9 Sep 1969.

A method is described for converting cyclohexane to a cyclohexanone. The cyclohexane is irradiated with penetrative ionizing radiation at an oxygen pressure that results in a cyclohexanone-to-cyclohexanol product ratio greater than 1. (auth)

14898 METHOD OF IMPROVING THE TACK OF ETHYLENE–PROPYLENE POLYMERS BY RADIATION. Soldatos, Anthony C. (to Union Carbide Corp.). U. S. Patent 3,616,362. 26 Oct 1971. Filed 2 Apr 1968.

A method was developed for improving the tack of ethylene–propylene polymers in a relatively short period of time by adding thereto a polymeric phenolic tackifier and exposing the resultant compositions to ionizing radiation or nonionizing radiation. (auth)

14899 PROCESS OF TREATING RADIATION-SENSITIVE POLYMERS. D'Alelio, Gaetano F. (to PPG Industries, Inc.). U. S. Patent 3,616,364. 26 Oct 1971. Filed 8 Apr 1969.

Highly radiation-sensitive crosslinkable polymers are produced whereby the polymers are treated by subjecting them to high-energy ionizing irradiation so as to produce three-dimensional crosslinked, insoluble, infusible polymers at relatively low doses of ionizing radiation. (auth)

14900 ELECTRON SPIN RESONANCE STUDY OF X-IRRADIATED SINGLE CRYSTALS OF SEMICARBAZIDE. Hamrick, Phillip J. Jr.; Shields, Howard; Whisnant, Carol C. (Wake Forest Univ., Winston-Salem, N. C.). Radiat. Res.; 48: No. 2, 234-43(Nov 1971).

Free radicals of the structure $H_2N-CONH\dot{N}H$ have been identified from their ESR spectra in x-irradiated single crystals of semicarbazide and the deuterated form, $ND_2CONDND_2$. Principal values for the hyperfine coupling constants and their direction cosines with respect to the reference axes are given. The results indicate that the unpaired electron is mainly localized in a π-type orbital centered on the α-nitrogen. (auth)

14901 PARAMAGNETIC SPECIES AND THEIR REACTIONS IN GAMMA-IRRADIATED CRYSTALLINE ACETONITRILE. Sprague, Estel Dean. Knoxville, Tenn.; Univ. of Tennessee (1971). 161p. University Microfilms Order No. 71-29,496.

Thesis.

A detailed kinetic study, utilizing both optical and ESR spectroscopic techniques, was carried out on γ-irradiated acetonitrile and the series of partially deuterated acetonitriles in the high-temperature crystalline phase, metastabilized by quenching to 77°K. Gamma irradiation results in the formation of dimer radical anions of acetonitrile in this crystalline phase. These anions are characterized by an ESR spectrum showing hyperfine structure due to two equivalent nitrogen atoms and by a broad optical absorption with a maximum at 510 nm. The optical absorption shows extensive vibrational fine structure, but interpretation was precluded by inadequate resolution at 77°K. Photobleaching the γ-irradiated samples results in the disappearance of the dimer radical anions and the formation of methyl radicals. (TSS)

14902 ELECTRON SPIN RESONANCE STUDY OF THE SO_2^- FORMATION IN THE THERMAL DECOMPOSITION OF SODIUM DITHIONITE, SODIUM AND POTASSIUM METABISULFITE, AND SODIUM HYDROGEN SULFITE. Janzen, Edward G. (Univ. of Georgia, Athens). J. Phys. Chem.; 76: No. 2, 157-62 (20 Jan 1972).

The thermal decomposition of sodium dithionite ($Na_2S_2O_4$), sodium and potassium bisulfite ($Na_2S_2O_5$, $K_2S_2O_5$), and sodium hydrogen sulfite ($NaHSO_3$) gives sulfur dioxide radical anion ($SO_2^-\cdot$) as an ESR detectable transient reaction product. The $SO_2^-\cdot$ present in commercial sodium dithionite samples decays rapidly to a lower "steady state" level at 180 to 220°. The $SO_2^-\cdot$ radical is detected in sodium and potassium bisulfite as a reaction product which first increases and then decreases in amount as a function of time at temperatures between 200 and 230° for $Na_2S_2O_5$ and 238 and 280° for $K_2S_2O_4$. Similar results are found in heating sodium hydrogen sulfite except that the amount of $SO_2^-\cdot$ detected is less. Radical yields are compared with those from γ radiolysis. It is concluded that those compounds which evolve SO_2 upon heating may all give detectable amounts of $SO_2^-\cdot$ as an intermediate reaction product. (auth)

14903 PHOTOLYSIS OF HYDROXYLAMINE IN AQUEOUS SOLUTION. Behar, D.; Shapira, D.; Treinin, A. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 76: No. 2, 180-6(20 Jan 1972).

The photolysis of NH_2OH in aqueous solution at 2139 Å can be closely represented by the overall reaction $3NH_2OH \rightarrow NH_3 + N_2 + 3H_2O$, with some H_2 also produced. Flash photolysis and pulse radiolysis of hydroxylamine solutions have proved that NHOH is an intermediate in the photolysis, and the properties of this radical were investigated. The effect of ethanol on the yields of NHOH and the final products strongly suggest that the major primary process is $NH_2OH \xrightarrow{h\nu} NH_2 + OH$. A minor parallel process leads to the production of H_2. The photolysis of NH_3OH^+ was also investigated. At pH ~2 the major nitrogen-containing products are NH_3 and N_2O. This change is related to transformation of the hydroxylamino radical to its acidic form (pK = 4.0 ± 0.1). Additional information is presented on the reactions of hydroxylamine with OH, H, and e_{aq}^-. The rate constants derived: $K(e_{aq}^- + NH_2OH) = 6.6 \times 10^8\ M^{-1}\ sec^{-1}$, $k(e_{aq}^- + NH_3OH^+) = 1.0 \times 10^{10}\ M^{-1}\ sec^{-1}$. (auth)

14904 RADIATION-INDUCED COPOLYMERIZATION OF CHLOROTRIFLUOROETHYLENE WITH ETHYL VINYL ETHER. Tabata, Y.; Du Plessis, T. A. (Tokyo Univ.). J. Polym. Sci., Part A-1; 9: No. 12, 3425-35(Dec 1971).

The γ radioinduced copolymerization of chlorotrifluoroethylene with ethyl vinyl ether was investigated in the liquid phase at 20 and –78°C over a wide range of monomer compositions. A copolymer was obtained in which the monomers alternate with regularity along the polymer chain over the entire range of monomer compositions investigated. Both the rate of copolymerization and the intrinsic viscosity of the resulting copolymer were found to depend strongly on the initial monomer composition, both reaching a maximum value at an equimolar concentration of the monomers. The monomer reactivity ratios were determined and correspond well with calculated values. A decrease in the irradiation temperature was accompanied by a marked decrease in the rate of copolymerization and the intrinsic viscosity of the copolymer. (auth)

14905 RADIATION CHEMISTRY OF AQUEOUS POLY(ETHYLENE OXIDE) SOLUTIONS. II. HIGHLY PURIFIED SAMPLES. Ward, J. A. (Union Carbide Corp., Tuxedo, N. Y.). J. Polym. Sci., Part A-1; 9: No. 12, 3555-61(Dec 1971).

The radiation chemistry of highly purified, rigorously degassed aqueous solutions of poly(ethylene oxide) is markedly different from solutions not so treated. Gelation doses are lower in the purified samples by almost two orders of magnitude. Degradation is unimportant in dilute solutions. The very broad molecular weight distribution as well as the very high molecular weight of these polymers makes the interpretation of the results difficult. Neither gel dose measurements nor solubility measurements give valid crosslinking yields. The crosslinking yield is highly concentration-dependent. (auth)

14906 ^{60}Co-INITIATED COPOLYMERIZATION OF STYRENE WITH VINYL ACETATE. Niezette, Joseph; Desreux, Victor (Univ., Liege). J. Polym. Sci., Part A-1; 9: No. 12, 3595-3606(Dec 1971).

The kinetic behavior of the ^{60}Co-initiated copolymerization at 25°C of styrene with vinyl acetate at 1100 and 2000 rad/hr was studied. As in the case of thermal and photochemical copolymerizations of these monomers, the growing chains are particularly rich in styrene units, and the overall rate is affected by a diluent effect due to the vinyl acetate monomer. However, in the case of the radiation copolymerization, this effect is partially counterbalanced by an increase of the initiation rate with the vinyl acetate concentration; the polymerization rate curve shows a maximum at a vinyl acetate molar fraction of 0.25. This effect is due to the very different free radical yields of these two monomers. The experimental results may be understood on the basis of a kinetic scheme which involves an energy transfer process from the excited vinyl acetate molecules to the styrene monomer and a termination reaction of the growing chains by very short styrene radicals when the mixture is rich in vinyl acetate. (auth)

14907 RADIATION-INDUCED IONIC POLYMERIZATION CONTROLLED BY THE PRESENCE OF LEWIS ACIDS OR LEWIS BASES. Williams, Thomas F. (to United States Atomic Energy

Commission). U. S. Patent 3,616,369. 26 Oct 1971. Filed 9 Nov 1967.

A method is described for controlling the molecular weight of a polymer derived from an ethylenically unsaturated monomer, which can be catalyzed to polymerize by a Lewis acid. The monomer is mixed with a Lewis base soluble in the monomer, and then the mixture is caused to react with an amount of high-energy radiation at least sufficient to initiate and propagate polymerization of the monomer. The Lewis base is selected from the class that functions to determine the molecular weight of the polymer produced at a given radiation dosage and temperature. The monomer is selected from an ethylenically unsaturated monomer having electron-releasing groups attached directly or indirectly to the ethylenic linkage of the monomer, which impart a Lewis base character to the monomer. The molecular weight of a polymer derived from a monomer that can be catalyzed by a Lewis base can be controlled. In that case, the molecular weight of the final polymer can be controlled by mixing the monomer with a Lewis acid and then irradiating the mixture at a given temperature and to a given radiation dosage. (auth)

14908 RADIATION-INDUCED POLYMERIZATION OF 1,2-CYCLOHEXENE OXIDE IN THE PLASTIC CRYSTALLINE STATE. Hiramoto, Tetsuo; Nishii, Masanobu; Hayashi, Koichiro; Okamura, Seizo (Japan Atomic Energy Research Inst., Osaka). J. Polym. Sci., Part A-1; 9: No. 12, 3647-59(Dec 1971).

Radioinduced solid state polymerization of 1,2-cyclohexene oxide was investigated. By the differential thermal analysis and x-ray diffraction analysis, it was found that this compound has a phase transition point at −81°C and behaves as a plastic crystal in the temperature range from −81°C to −36°C (melting point). The in-source polymerization proceeded not only in the plastic crystalline state but also in the ordinary crystalline state at temperatures below the phase transition point. The overall rate of polymerization and the rate of chain transfer to monomer in the plastic crystalline state were larger than those in the ordinary crystalline state by a factor of about forty, but the kinetic mechanisms were identical, i.e., the termination mechanisms were unimolecular in both solid states. In contrast, the kinetic mechanisms in the plastic crystalline state and in the liquid state were different. From these observations, the effects of molecular motion and molecular arrangement on the polymerizations of 1,2-cyclohexene oxide in the three phases were discussed. (auth)

14909 STEADY STATE AND PULSE RADIOLYSIS STUDIES OF Cl_2^-· REACTIVITY IN MICELLAR SYSTEMS. Fendler, J. H. (Texas A and M Univ., College Station); Fendler, E. J.; Bogan, G.; Patterson, L. K.; Bansal, K. M. J. Chem. Soc. D; No. 1, 14-16(5 Jan 1972).

Rate constants for reactions of Cl_2^-· with charged and neutral surfactants are significantly smaller above the critical micelle concentrations than below them. The subsequent reactions, rather than the formation of the uracil−Cl_2^-· adduct, are affected by micellization. (auth)

14910 METHOD FOR THE RADIATION POLYMERIZATION OF POLYOXYMETHYLENE. Ishigaki, Isao; Ito, Akihiko; Iwai, Tadashi (to Japan Atomic Energy Research Inst.). U. S. Patent 3,616,368. 26 Oct 1971. Priority date 20 May 1968, Japan.

Polyoxymethylenes were obtained by first irradiating trioxane and/or tetraoxane with ionizing radiation, then contacting the irradiated trioxane and/or tetraoxane with nonirradiated trioxane and/or tetraoxane, and then maintaining the resulted mixture under the polymerizing condition to thereby effect polymerization of the whole system including the nonirradiated trioxane and/or tetraoxane by the action of active species formed in the irradiated trioxane and/or tetraoxane to give polyoxymethylenes readily with a minimum dosage required for such irradiation. (auth)

14911 TEMPERATURE DEPENDENCE OF THE REACTION YIELDS FROM RECOIL TRITIUM REACTIONS. II. TRITIUM ATOM ADDITION TO 1-BUTENE AND cis-2-BUTENE. Kushner, Richard; Rowland, F. S. (Univ. of California, Irvine). Contract AT(04-3)-34. J. Phys. Chem.; 76: No. 2, 190-7(20 Jan 1972).

Energetic recoil tritium atoms react with 1-butene and cis-2-butene to form $CH_3CH_2CHCH_2T^*$ and $CH_3CHTCHCH_3^*$ radicals, respectively. The yields of the corresponding secondary decomposition products, $CH_2TCH{=}CH_2$ and $CH_3CH{=}CHT$, are higher when formed at 125° than at 24° over the pressure range from 50 to 1000 torr. This temperature dependence of yields is consistent with an increase in excitation energy corresponding to the increased internal energy of the butene molecules at the higher temperature. Decomposition rate constants most sensitive to these pressures (~10^9 to 10^{10} sec^{-1}) correspond to initial kinetic energies of tritium from about 10 to 40 kcal/mole; the median energy at which double-bond addition occurs is about 10 kcal/mole or less. The addition reaction of energetic tritium atoms with substrate olefins is apparently unaffected by the temperature of the substrate; the observable temperature effects are satisfactorily explained as the effects of substrate molecule temperature upon the secondary decomposition processes following the primary interaction. No temperature dependence was found for the hot products of energetic tritium atom reaction with CH_4: HT, CH_3T, and CH_2T (measured as CH_2TBr). (auth)

14912 PULSE RADIOLYSIS OF SODIUM METAPHOSPHATE GLASSES. Barkatt, Aaron; Ottolenghi, Michael; Rabani, Joseph (Hebrew Univ., Jerusalem). J. Phys. Chem.; 76: No. 2, 203-13(20 Jan 1972).

The effects of ionizing radiation on sodium metaphosphate glasses were investigated using pulse radiolysis techniques. In pure glasses the transient absorbance changes can be described by the consecutive exponential decays of three fractions exhibiting absorption maxima at 6900 Å (fraction I, $\tau_{\frac{1}{2}}$ = 3.2 μsec), 5600 Å (fraction II, $\tau_{\frac{1}{2}}$ = 0.29 msec), and 5200 Å (fraction III, $\tau_{\frac{1}{2}}$ = 6.3 msec). After all decays a residual permanent absorption at 5000 Å (fraction IV) is left. The effects of doping the glass with various metal cations were analyzed. Characteristic electron scavengers (e.g., Ag^+, Cd^{2+}, Pb^{2+}) were found to inhibit the formation of fraction I while hole scavengers (Ce^{3+}, Ag^+) prevent the formation of the other fractions. The effects were analyzed and attributed to reactions between the ions and the precursors of fraction I and fractions II-IV, the precursors being identified as very mobile electron-excess (e^-) and electron-deficiency (h^+) centers, respectively. Accordingly, the decaying fraction I is tentatively attributed to solvated electrons ($e_{\bar{l}}^-$) while fractions II-IV were assigned to various electron deficiency (hole) centers (h_{II}^+, h_{III}^+, h_{IV}^+). In Ag^+-doped glasses the very fast primary processes $Ag^+ + e^- \rightarrow Ag^0$ and $Ag^+ + h^+ \rightarrow Ag^{2+}$ were followed by slower reactions attributed to $Ag^0 + Ag^+ \rightarrow Ag_2^+$ and $h_{IV}^+ + Ag^+ \rightarrow Ag^{2+}$. The feasibility of a third process $Ag_2^+ + Ag^+ \rightarrow Ag^{2+} + Ag_2$ was considered. (auth)

14913 RADIOLYSIS OF HYDROGEN SELENIDE IN THE GAS PHASE. Forys, M.; Migdal, E. (Univ. of Warsaw). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 199-203(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 223-7(May-Jun 1971).

The radiolysis of hydrogen selenide was investigated in the presence or absence of hydrogen atom acceptors. Acceptors of atomic hydrogen with various degrees of effectiveness interact with hot and thermal hydrogen atoms. This leads to different values of G_H according to the activation energy of reaction of hydrogen with the given acceptor. The radiation yields of atomic and molecular hydrogen were determined. (auth)

14914 RADIOLYSIS OF HYDROGEN SULFIDE IN THE GAS PHASE: RADIATION YIELD OF ATOMIC HYDROGEN. Forys, M.; Migdal, E. (Univ. of Warsaw). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 204-10(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 228-35(May-Jun 1971).

The radiolysis of hydrogen sulfide was investigated in the presence of acceptors of atomic hydrogen. On the basis of the dependence of the observed values of G_H on the activation energy of combination of a hydrogen atom with the acceptor, it was concluded that hot hydrogen atoms are formed, and the radiation yield of hot and thermal hydrogen atoms was determined. (auth)

14915 ROLE OF HOT H ATOMS IN PROCESSES OF CLEAVAGE OF C–C BONDS IN THE GAMMA-RADIOLYSIS OF LIQUID ALKANES. Avdonina, E. N. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 211-14(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 236-40(May-Jun 1971).

Data on the radiolysis of n-alkanes are discussed on the basis of a mechanism including three processes leading to cleavage of C–C bonds: RH = $r_1 + r_2$ (cleavage with the formation of two radicals); RH = $m_1 + m_2$ (cleavage forming two molecules); and RH + H = $r_1H + r_2$ (introduction of a hot H atom at a C–C bond forming a molecule and a radical). It was shown that these three mechanisms participate in the cleavage of all the nonterminal bonds in 5 : 4 : 1 ratio. The terminal C–C bonds are evidently broken exclusively in the last process. (auth)

14916 RADIOLYSIS OF AQUEOUS SOLUTIONS OF AROMATIC GLUCOSIDES. Fel, N. S.; Nedoborova, L. I.; Kudryashov, L. I.; Dolin, P. I.; Kochetkov, N. K. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 215-20(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 241-6(May-Jun 1971).

In order to verify the mechanism of the transformation of aro-

matic glucosides in aqueous solutions under the influence of radiation, the final and intermediate (by the pulse-radiolysis method) products of radiolysis of dilute solutions of β-benzyl glucoside were studied. It was established that e^-_{aq}, H, and OH react with the aromatic portions of the molecules to form radicals of the cyclohexadienyl and hydroxycyclohexadienyl type. A portion of the e^-_{aq} reacts to break the glucoside bond. The stable products are formed by disproportionation and recombination reactions. The rate constants for the reactions of several glucosides with e^-_{aq} and OH were measured. (auth)

14917 INVESTIGATION OF THE KINETICS OF DESTRUCTION OF POLARONS IN THE SOLID PHASE BY THE NORMALIZED CONCENTRATION METHOD. Pernikova, T. E.; Kabakchi, S. A.; Shubin, V. N. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 221-5(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 247-52(May-Jun 1971).

The kinetics of the disappearance of polarons in neutral crystalline ice at 269 to 213°K were investigated by the pulse radiolysis method. It was established that the destruction of polarons proceeds via parallel first- and second-order reactions. The first- and second-order rate constants were calculated by the "normalized concentration" method by varying the initial concentration of polarons by factors of 10 to 15. The rate constant of the monomolecular process obeys the Arrhenius law: $k_1 = 5.4 \times 10^{14} \exp(-11{,}600/RT)$. It is proposed that the monomolecular decomposition of polarons is due to their thermal dissociation. The rate constant of the bimolecular reaction does not obey the Arrhenius law, which indicates the existence of a compensation effect. It was found that the true activation energy is 3.0 kcal/mole, while $k_0 = 2.5 \times 10^{12}$ liters/mole/sec. The disappearance of polarons via a bimolecular reaction is due chiefly to their interaction with H_3O^+ during migration of a proton to the polaron. (auth)

14918 KINETICS FOR THE CONVERSION OF RADICAL PAIRS IN IRRADIATED DIMETHYLGLYOXIME. Yakimchenko, O. E.; Lebedev, Ya. S. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 226-30 (May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 253-8(May-Jun 1971).

The EPR method was used to study the kinetics for the reaction of radical pairs that are formed during the radiolysis of dimethylglyoxime and dimethylglyoxime-d_2 at 77°K. It is shown that in both DMG and DMG-d_2 one type of pair is formed predominantly in the primary act of the radiolysis with an average distance between the unpaired electrons of 5.4 Å. Two types of reactions for valence migration and the reaction for the disproportionation of the radicals were studied. The values of the rate constants and the values of the isotopic kinetic effect were determined which show that the tunnel transfer of hydrogen plays an important part. (auth)

14919 γ-RADIATION INITIATED ISOMERIZATION OF CYCLOHEXANOL TO CAPROIC ALDEHYDE. Ladygin, B. Ya. High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 242-3(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 269-70(May-Jun 1971).

Results of a study of the irradiation of cyclohexanol in the solid and liquid state show that at low temperature (from –196°C up to phase transition temperature) mainly dehydrogenation of cyclohexanol takes place. The phase transition into the liquid state is accompanied by the appearance of caproic aldehyde, carbon monoxide, and n-pentane. At high temperatures n-hexyl alcohol was also detected. The character of the kinetic curves indicates that caproic aldehyde is the primary molecular product of cyclohexanol radiolysis while carbon monoxide, as well as the n-pentane, n-hexyl alcohol, and the main part of the cyclohexanone (at high temperature) are formed as the result of secondary conversions that take place simultaneously with a reduction in the rate of aldehyde build-up to zero. (D.H.M.)

14920 PHOTOCHEMICAL TRANSFORMATIONS OF RADICAL PAIRS IN CRYSTALLINE DIMETHYL GLYOXIME. Yakimchenko, O. E.; Lebedev, Ya. S. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 244-5(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 271-2(May-Jun 1971).

A study is reported of the photochemical transformation of radicals and radical pairs in γ-irradiated dimethylglyoxime and hydroxy-group deuterated dimethylglyoxime at 77°K. When samples containing single radicals and radical pairs of any structure are irradiated at 77°K with $\lambda \leq 400$ nm, the intensity of the EPR signal belonging to a radical pair decreases at least by one order faster than the EPR signal of a single radical. The rate of disappearance of the original radical pair is proportional to the light intensity and the kinetic curves of the reaction correspond to the 1st order equation up to 75% conversion at the original concentration of the radicals and radical pairs up to 10^{18} g^{-1}. It was concluded that the reactions studied are most likely due to the excitation in the radical absorption band and represent elementary reactions of hydrogen transfer both within the excited radical and between neighboring radicals or between a radical and a molecule. (D.H.M.)

14921 STUDY OF THE FORMATION AND REACTIONS OF CYCLOHEXYL RADICALS BY PULSE RADIOLYSIS. Makarov, V. I.; Kabakchi, S. A. (Inst. of Petrochemical Synthesis, Moscow. Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 246-8(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 272-4(May-Jun 1971).

The formation and the loss kinetics of cyclohexyl radicals in the pulse radiolysis of cyclohexane was investigated. The effects of oxygen, cyclohexene, and carbon dioxide on the reactions of cyclohexyl radicals were studied. (D.H.M.)

14922 DICHLORIDE ION IN γ-IRRADIATED FROZEN HCl SOLUTIONS. Belevskii, V. N.; Bugaenko, L. T. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 252-3(May-Jun 1971).

The EPR method was used to study the free radicals that are formed upon radiolysis of frozen aqueous HCl solutions having acid concentrations of 0.1 to 13.5 molar. In the EPR spectrum of 0.1 M HCl there is present basically a doublet for OH radicals, with a splitting of 42 oersteds. With increase in HCl concentration the contribution of the OH radical to the overall spectrum falls off, and lines of another radical appear, which were identified as Cl_2^-. The intensity of the Cl_2^- lines rises approximately proportionally to the acid concentration. Its yield reaches 3.6 radicals per 100 eV in 13.5 M HCl. Together with these signals, a doublet for hydrogen atoms is visible in the EPR spectrum of concentrated HCl solutions; these are formed in low yield. (D.H.M.)

14923 FORMATION OF PARAMAGNETIC CENTERS IN THE RADIOLYSIS OF POLYDIMETHYLSILOXANES CONTAINING THE meta-TRIFLUOROMETHYLPHENYL GROUP. Kozlov, V. T.; Ponomarev, A. I.; Larionova, Yu. A.; Kashevskaya, N. G. (Scientific-Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 3, 256(May-Jun 1971).

Translated from Khim. Vys. Energ.; 5: No. 3, 280(May-Jun 1971).

The effect of the structure of poly(dimethylsiloxane) containing different amounts of meta-trifluoromethylphenyl group on the yield of free radicals (G_R) was studied. Results show that on increasing the mole % of substituting rings in poly(dimethylsiloxane), the radiation stability of the molecules to decomposition increases. (D.H.M.)

14924 ALPHA RADIOLYSIS OF HYDROGEN SULPHIDE–RARE GAS MIXTURES. Jezierska, Krystyna (Univ., Warsaw). Nukleonika; 16: No. 5-6, 213-21(1971).

The energy transfer in α-irradiated gas systems: $H_2S + Ar$, $H_2S + Kr$, $H_2S + Xe$ was studied. The energy-transfer efficiency depends upon the kind of the rare gas and the fraction of energy absorbed by it. A maximum of the sensitization process was found to exist in $H_2S + Ar$ mixtures. The energy transfer efficiency for 0.9 F_{Ar} was estimated at 82%. An interpretation of the observed sensitization process is proposed, and the results obtained are discussed. (auth)

14925 RADIATION-INDUCED RADIOLYSIS OF ALIPHATIC SATURATED ACID AMIDES. Zurakowska-Orszagh, Janina; Brzezinska, Anna (Univ., Warsaw). Nukleonika; 16: No. 5-6, 203-12(1971). (In Polish).

The radiolysis products of propionic and butyric acid amides submitted to γ irradiation in the solid state were investigated. The doses used amounted to 30, 40, and 50 Mrads. Using gas chromatography the following products were detected in the case of propionamide: hydrogen, carbon monoxide, methane, ethane, propane, n-butane, methyl ethyl ketone, propionaldehyde, acetonitrile, and propionitrile; and in the case of butyramide: hydrogen, carbon monoxide, methane, ethane, propane, n-butane, n-pentane, butyraldehyde, acrylonitrile and butyronitrile. The G-values of the gaseous products for the compounds examined and the applied doses were determined; they appear to increase with increasing absorbed doses. On the basis of these data the mechanism of decomposition of amides under the influence of γ radiation was proposed. (auth)

14926 RADIOLYSIS OF KI–N_2O SYSTEM. Singal, R. K. (Univ. of Detroit). Indian J. Chem.; 9: No. 7, 724-6(Jul 1971).

^{60}Co-γ-radiolysis of aqueous KI solution (5×10^{-3}M) in the presence of N_2O was reinvestigated. Certain discrepancies were observed in $G(N_2)$ and $G(H_2)$ values as compared to those reported in literature. It is observed that in liquid nitrogen $G(N_2)$ and $G(O_2)$ are zero in the first freeze-pump cycle but not in the second and third cycles. In addition, it is found that $G(N_2)$ and $G(O_2)$ are dependent upon the refrigerant used after γ-radiolysis. This was suggested to be due to the formation of structures between N_2O and negative water cluster. (auth)

14927 γ-RADIATION-INDUCED POLYMERIZATION OF SOLID N-(1,1-DIMETHYL-3-OXOBUTYL)-ACRYLAMIDE. Purcell, Thomas Owen Jr. Louisville, Ky.; Univ. of Louisville (1970). 107p. University Microfilms Order No. 71-12,476.

Thesis.

The samples were placed in the cobalt-60 source for different lengths of time. The geometry of the sources allowed for four different intensities of 41,000, 57,000, 89,000, and 127,000 rad/hr. At a constant intensity, plots of log percent polymer vs time are linear in the region studied. This fact requires that the polymerization be first order with respect to polymer. The intensity of radiation was considered to affect the rate as follows: $dP/dt = k\,P\,I^{\alpha}$. Using different intensities and the same percent conversion it can be shown that $\log (dP/dt) = \log k + \log P + \alpha \log I$. The values for dP/dt and k were determined by a computer based least square method. A least squares analysis gave a value of $\alpha = 0.50 \pm 0.03$. The initial rate equation can then be written as: $dP/dt = 7.07 \times 10^{-4}\,P\,I^{\frac{1}{2}}$ at 22°C. In addition to the 22°C experiments, runs were also conducted at 0°C and –20°C for which k was found to be 5.44×10^{-4} and 3.87×10^{-4} respectively. From this data and the conventional Arrhenius plot an activation energy of 2.1 kcal/mole was determined. Plots of intrinsic viscosity of polymer produced vs time all exhibited a maximum. A decrease in molecular weight with time could correspond to an increase in production of small molecules, destruction of high polymer by radiation, or both. The largest maxima in the plots was observed at 89,000 rad/hr indicating an optimum intensity effect. No apparent correlation, other than this, could be drawn for the remainder of the intensity data. The maximas increased regularly with decreasing temperature indicating that reduced movement within the crystal lattice favored higher molecular weight product. This could also be caused by a low dependence of the energy of propagation on temperature. Both air and oxygen atmospheres increased the induction period of the reaction but left the rate unchanged. It is felt that strain is the dominating influence in the solid-state polymerization of diacetone acrylamide and the vast majority of other monomers polymerizing in the solid state. Strain must be present not only for propagation but also for the initiation and termination reactions to proceed at significant rates. Molecular weight data also indicates a strain controlled chain transfer to monomer step. Bimolecular termination and a modified steady state are necessary to obtain the proper form of the rate equation. Although neither of these assumptions are commonly made in solid state investigations, there appears to be no good reason to reject them, especially at these relatively high temperatures and low degrees of conversion. (Diss. Abstr. Int., B)

14928 INFRARED SPECTROSCOPIC STUDY OF THE CHANGES IN THE PHYSICOCHEMICAL STRUCTURE OF IRRADIATED AV-17 ANION-EXCHANGE RESIN. Kiseleva, E. D.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 6, 850-3(Jun 1971).

Translated from Zh. Fiz. Khim.; 45: No. 6, 1509-12(Jun 1971).

The changes in the physicochemical structure of AV-17 resin on irradiation with cobalt-60 γ radiation at a dose of 3×10^8 to 1×10^9 rad in a vacuum, in air, in water, and in 7N HNO_3 have been investigated by infrared spectroscopy and potentiometric titration. Under the conditions investigated, the ion-exchange groups are decomposed and the macromolecular skeleton is oxidized with formation of aldehydes and carboxylic acids. (auth)

14929 CARBON TETRACHLORIDE AS AN ELECTRON SCAVENGER IN HYDROGEN BROMIDE. McCracken, David R.; Armstrong, D. A. (Univ. of Calgary, Alta.). J. Chem. Phys.; 55: No. 2, 982-3(15 Jul 1971).

When CCl_4 is used as the electron scavenger in HBr the only new carbon containing product is chloroform. After removal of excess HBr from the irradiated mixture by sublimination at –125°C, $CHCl_3$ was quantitatively determined by gas chromatography. From a plot of reciprocal yields of H and chloroform it was determined that the yield of scavengeable electrons is 3.0. (D.H.M.)

14930 RADIOLYTIC OXIDATION OF LEUCO CRYSTAL VIOLET. Kumar, S. S.; Merklin, J. F. (Kansas State Univ., Manhattan). Nucl. Instrum. Methods; 97: No. 3, 597-602(1971).

In the radiolysis of solutions of leuco crystal violet in benzene–bromobenzene mixtures, a significant amount of oxidation occurred under aerated conditions. In an aerated solution of benzene containing 10^{-3} M leuco crystal violet and 0.096 M bromobenzene, the yields of crystal violet ion, biphenyl, and benzene were respectively 1.06, 0.75, and 0.96 molecules per 100 eV. In the same solution, under degassed conditions, the estimated yields of crystal violet ion and biphenyl were 0.075 and 1.76, respectively. Benzene formation was found to be negligible. Reaction mechanisms consistent with the observed effects are proposed for degassed and aerated conditions. The potential of this system as a dosimeter for γ rays is also discussed. (auth)

14931 INFRARED AND ELECTRON SPIN RESONANCE STUDIES OF THE EFFECT OF γ-IRRADIATION ON $[Cr(CN)_5NO]^{3-}$, $[Mn(CN)_5NO]^{3-}$, AND $[Fe(CN)_5NO]^{2-}$ IN ALKALI-METAL HALIDE HOST LATTICES. Bloom, M. B. D.; Raynor, J. B.; Root, K. D. J.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., A; No. 20, 3212-16(1971).

Ir and ESR spectra of γ-irradiated $[Cr(CN)_5NO]^{3-}$, $[Mn(CN)_5NO]^{3-}$, and $[Fe(CN)_5NO]^{2-}$ in alkali-metal halide host lattices are reported. New ir absorptions are attributed to species resembling $[Cr(CN)_5NO]^{4-\text{ and }5-}$ and $[Mn(CN)_5NO]^{2-\text{ and }4-}$. There is ESR evidence for the formation of $[Mn(CN)_5NO]^{3-}$ and $[Fe(CN)_5NO]^{3-}$ ions, but no feature attributable to $[Cr(CN)_5NO]^{5-}$ or $[Mn(CN)_5NO]^{4-}$ was detected. Possible reasons for this apparent contradiction are discussed. There was evidence for the metal ion in $[Mn(CN)_5NO]^{3-}$ migrating through the lattice to sites where it could exist in the high-spin d^5 form. (auth)

14932 RADIATION IONIC GRAFT COPOLYMERIZATION. Kabanov, V. Ya.; Sidorova, L. P.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 198: No. 4, 883-4(1 Jun 1971). (In Russian).

Radiation grafting was conducted with monomers of α-methylstyrene, vinyl n-butyl ether, isobutylene, epichlorohydrin, and vinylcyclohexane. As a base for grafting, polyethylene, Teflon, and poly(vinyl chloride) were used. Drying of each monomer was performed by standing for one month over Na metal. Polymer films were dried over P_2O_5, and then immersed in a given monomer while exposed to ^{60}Co γ-radiation (0.5 MR) at room temperature. The percent of grafting was indicated by the gain in weight of a film, and proved to be strongly dependent on the thoroughness of the drying of the monomer. Accordingly, other drying agents were evaluated for this purpose. (K.S.W.)

14933 PULSE RADIOLYSIS STUDIES ON REACTION OF TRIACETONEAMINE-N-OXYL WITH RADIATION-INDUCED FREE RADICALS. Willson, R. L. (Mount Vernon Hospital, Northwood, Eng.). Trans. Faraday Soc.; 67: No. 586, 3008-19 (Oct 1971).

Absolute rate constants for the reactions of the stable free radical triacetoneamine-N-oxyl (TAN) with a variety of radiation-induced radicals were determined by direct observation or by competition methods. Like oxygen, TAN reacts rapidly with the electron adducts of acetophenone, thymine and nicotinamide adenine dinucleotide ($k = 10^8$ to 10^9 M^{-1} s^{-1}) and reacts slowly, if at all, with the electron adducts of p-nitroacetophenone and benzoquinone. Absolute rate constants for the reaction of TAN with neutral aliphatic radicals are, in general, an order of magnitude lower than the analogous reactions with oxygen. Unlike oxygen, TAN also reacts with halide radical anions, X_2^-, at near diffusion-controlled rates. (auth)

14934 PULSE RADIOLYSIS STUDY OF CYCLIC PEPTIDES IN AQUEOUS SOLUTION. ABSORPTION SPECTRUM OF THE PEPTIDE RADICAL NHCHCO. Hayon, E.; Simic, M. (Army Natick Labs., Mass.). J. Amer. Chem. Soc.; 93: No. 25, 6781-6 (15 Dec 1971).

The pulse radiolysis of aqueous solutions of the cyclic dipeptides of glycine, alanine, and sarcosine was studied. The rate constants for reaction of e_{aq}^- and of OH radicals with these anhydrides were found to be $\sim 2 \times 10^9$ M^{-1} sec^{-1}, independent of pH in the range 5 to 13. Hydrogen atom abstraction by OH radicals produces characteristic transient absorptions with maxima at ~265 and 365 nm and extinction coefficients of ~8500 and 2500 M^{-1} cm^{-1}, respectively. These absorption spectra are essentially the same for the three cyclic dipeptides, and are assigned to the peptide radical, e.g., $-NH\dot{C}HCO-$, for glycine anhydride. In alkaline solutions, glycine and alanine anhydrides produce transient spectra which are red shifted. From an examination of the acid-base properties of these radicals, $pK_R = 9.6 \pm 0.2$ was determined. Sarcosine anhydride shows no change in alkaline solution. These results are interpreted to be due to the deprotonation of the peptide hydrogen adjacent to the unpaired electron: $\underbrace{NH\dot{C}HCONHCH_2CO} + OH^- \rightleftharpoons -\underbrace{N\dot{C}HCONHCH_2CO} + H_2O$. Ionic strength effects on the second-order decay of this radical were observed. The rate constant of

this proton-transfer reaction was found to be $k = 8.0 \pm 2.0 \times 10^8$ M^{-1} sec^{-1} for glycine anhydride. The reactivity of these peptide radicals with oxygen was measured, $k(R\cdot + O_2) \sim 10^9$ M^{-1} sec^{-1}. The hydrated electron reacts with cyclic dipeptides to produce the corresponding electron adducts: e.g., $\underline{NHCH_2C(O^-)NHCH_2C}O$. The rates of electron transfer from these ketyl radicals to sulfhydryl and disulfide acceptors were found to be $\sim 2 \times 10^8$ M^{-1} sec^{-1}, and to aromatic ketones $\sim 2 \times 10^9$ M^{-1} sec^{-1}. (auth)

14935 HALOGEN ATOM ADDITIONS TO OLEFINS. AN ELECTRON SPIN RESONANCE STUDY OF THE INTERMEDIATES. Lyons, A. R.; Symoms, M. C. R. (Univ. pf Leicester, Eng.). J. Amer. Chem. Soc.; 93: No. 26, 7330-1(29 Dec 1971).

ESR studies of γ-irradiated tert-butyl halides (chloride, iodide, and bromide) at 77°K show that radicals are formed that are characterized by very large splitting between the components associated with hyperfine coupling to the halogen nuclei. Similar radicals were prepared by exposing frozen solutions containing ethylene and bromine or iodine to ultraviolet light. (D.H.M.)

14936 INTENSITY DEPENDENCE OF THE γ-RADIATION-INDUCED POLYMERIZATION OF SOLID N-(1,1-DIMETHYL-3-OXOBUTYL)-ACRYLAMIDE (DIACETONE ACRYLAMIDE). Lipscomb, N. Thornton (Univ. of Louisville, Ky.); Purcell, T. O. J. Polym Sci., Part B; 9: No. 11, 831-7(Nov 1971).

In an effort to obtain a qualitative picture of the polymerization processes, an investigation was made of the γ-induced polymerization of solid diacetone acrylamide that considered the effect of the polymer concentration and the effect of the intensity of radiation on the rate of polymerization. (D.H.M.)

14937 SOLUTE RADICAL CATION YIELDS IN THE PULSE RADIOLYSIS OF SOLUTIONS OF AROMATIC AMINES IN CHLORINATED HYDROCARBONS. Burrows, H. D.; Greatorex, D.; Kemp, T. J. (Univ. of Warwick, Coventry, Eng.). J. Phys. Chem.; 76: No. 1, 20-6(6 Jan 1972).

G values for solute radical cations were determined by microsecond pulse radiolysis of 10^{-2} M solutions of N,N,N′,N′-tetramethyl-p-phenylenediamine, p,p′,p″-tribromotriphenylamine, tritolyamine, triphenylamine, aniline, and 2,4,6-tri-tert-butylphenol in carbon tetrachloride and, in the case of the first four solutes, also in chloroform, dichloromethane, and chlorocyclohexane. They are in most cases considerably higher than those previously reported. There is evidence for selective scavenging of $RCl\cdot^+$ by the trisubstituted triarylamines while TMPD appears to scavenge a solvent radical in addition in the cases of $CHCl_3$ and CCl_4. Extinction data were independently determined for the solute radical cations by chemical oxidation. (auth)

14938 EFFECT OF GAMMA RADIATION ON ION EXCHANGE RESINS. III. INVESTIGATIONS OF THE RADIOLYSIS PRODUCTS OF ZEROLIT FF-IP BY THE EPR METHOD. Litowska, M.; Narebska, A.; Basinski, A. (Nicholas Copernicus Univ., Torun, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 19: No. 6-7, 439-46(1971).

The radical products of radiolysis of Zerolite FF-IP were studied by the EPR method. Two kinds of radicals were detected. One of them is formed from the skeleton of the resin and gives a narrow resonance line in the spectrum, which probably corresponds to oxygen and peroxide radicals that are formed as a result of oxidation of polystyrene chains. The second kind of radical gives a wider resonance line in the spectrum. These radicals are formed in the functional groups zone of the resin. Their recombination rate at room temperature is much faster and their resistance to the action of air is lower than those of the macroradicals formed from the hydrocarbon framework of the resin. (auth)

14939 FREE RADICALS IN A GLUTARIC ACID SINGLE CRYSTAL UNDER γ-IRRADIATION AT 77°K. Yudanov, V. F.; Tsvetkov, Yu. D. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 339-40(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 373-4(Jul-Aug 1971).

A study was made of single crystals of glutaric acid, irradiated at 77°K (dose ~4 Mrad). The single crystals were obtained by evaporating a saturated aqueous solution. EPR spectra were registered for the following orientations of the crystals in the magnetic field: $H_0(1,0,0)$, $H_0(0,1,0)$, $H_0(0,0,1)$, and $H_0(l,0,n)$, where l, m, and n are the direction cosines in the orthogonal system of coordinates x = a, y = b, z = c (a, b, c the basal crystallographic axes). Mechanisms for the production of free radicals that have been identified are discussed. (J.G.B.)

14940 FORMATION OF SOLVATED ELECTRONS IN HEXAMETHYLPHOSPHORAMIDE UNDER IMPULSE IRRADIATION. Mal'tsev, E. I.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 337-8(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 371-3(Jul-Aug 1971).

A short-lived optical absorption in the spectral region λ 600 to 1600 nm was formed during the pulsed electron radiolysis of hexamethylphosphoric triamide. Its disappearance took place by a first order reaction having a rate constant $k_{opt} = 3 \times 10^5$ sec^{-1}. First order kinetics of disappearance show that an electron acceptor is present in the irradiated liquid. Addition of anthracene led to the disappearance of the solvated electron spectrum and the appearance of a short-lived spectrum (duration about 100 μsec) with a maximum at λ 730 nm, which is characteristic of the anthracenide ion. Values were obtained for the radiation yield of the solvated electron (1.2) and the extinction coefficient ($\epsilon_{1600} = 2.8 \times 10^3$). (J.G.B.)

14941 MECHANISM OF PHOTOCHEMICAL REACTIONS IN FROZEN SOLUTIONS OF COMPLEX COMPOUNDS OF Pt(IV). Shagisultanova, G. A.; Karaban, A. A.; Poznyak, A. L. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 333-4(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 368-9(Jul-Aug 1971).

A study was made on initial stages and primary processes in the reactions excited by uv light, solutions (C = 10^{-3} M) of $[Pt\ en_3]Cl_4$, $[Pt\ gly_3]Cl$, $[Pt(NH_3)_4I_2](NO_3)_2$, $[Pt(NH_3)_5I]_2(CO_3)_3$, and K_2PtX_6, where en represents ethylenediamine, gly represents glycine, and X represents Cl^-, Br^-, or I^-, frozen at ~80°K, were irradiated for 10 to 120 min in a medium of 5M H_2SO_4, 5M H_3PO_4, and 10M LiCl. Results of EPR studies indicate that uv radiation excites the transfer of one electron from the medium to the central atom, probably according to a bridge mechanism, in which the role of the bridge is played by ligands. For a further substantiation of the presumed mechanism, a study was made of the photochemistry of frozen solutions of $[Pt\ gly_3]Cl$ (C = 10^{-3} M) in an ethylene glycol–water matrix in the presence of organic acids: acetic, malonic, lactic, and amygdalic. It was found that in all cases processes of photoinduced oxidative decarboxylation occur, with the formation of three radicals of the type:

$$\dot{C}H_3CH_2COOH,\ CH_3-\underset{\displaystyle OH}{\underset{|}{\dot{C}H}},\ C_6H\underset{\displaystyle OH}{\underset{|}{\dot{C}}}H_5,$$

identified according to the EPR spectra. Pt^{2+} was also found in the frozen irradiated samples. The primary product of the one-electron reactions under consideration is Pt(III); however, it was not identified according to the EPR spectrum. In connection with this, it is interesting to note that in the irradiation of frozen (77°K) 5×10^{-2} M solutions of $[Pt\ en_3]^{4+}$ and $[Pt\ gly_3]^+$ with x rays (dose rate 6.2×10^{15} eV/ml · sec), an EPR spectrum was obtained that was assigned to the Pt(III) ion. This is a triplet with a g-factor of the central line of 2.31. (J.G.B.)

14942 MECHANISM OF THE RADIATION DEHYDROCHLORINATION OF POLYVINYL CHLORIDE. Sukhov, F. F.; Slovokhotova, N. A.; Kargin, V. A. (Physicochemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 329-30(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 364-5(Jul-Aug 1971).

Previously reported studies indicate that the very broad band ($\Delta\nu_{\frac{1}{2}} = 300$ cm^{-1}) with a maximum at approximately 2300 cm^{-1} and observed in the ir spectrum of poly(vinyl chloride) (PVC) that has been irradiated under vacuum at 77°K is partially explained by the formation of complexes of HCl with impurities of oxygen-containing groups present in the original polymer. It is suggested that the part of the absorption in the 2300 cm^{-1} region which disappears at 200°K is caused by CH valence stretching vibrations in an $\sim CH_2 - \overset{+}{C}H - CH_2\sim$ carbonium ion present in the field of a chloride anion. A study of the spectra of irradiated isopropyl chloride, n-propyl chloride, t-butyl chloride, and poly(vinylidene chloride) confirmed the assignment. (J.G.B.)

14943 RADIOLYSIS OF SULFURIC ACID SOLUTIONS OF ETHYLENE GLYCOL CONTAINING Fe^{2+} IONS AND OXYGEN. Kartasheva, L. I.; Sosnovskii, O. A.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 327-8(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 362-3(Jul-Aug 1971).

Oxygen-saturated H_2SO_4 solutions of ethylene glycol and ferrous ammonium sulfate were subjected to γ irradiation. Yields of Fe^{3+} and carbonyl compounds were determined. The high yields

of products (particularly Fe^{3+}) indicate that chain reactions take place during irradiation. Since the product yields are independent of dose rate, recombination reactions of free radicals do not take place in the system; reactions of the radicals with Fe^{2+} result in chain termination. Data on the yields of carbonyl compounds indicate the occurrence of processes that are accompanied by the rupture of the carbon–carbon bond in the ethylene glycol molecule. (J.G.B.)

14944 NMR INVESTIGATION OF THE STRUCTURAL CHANGES IN RUBBER DURING LOW-TEMPERATURE RADIOLYSIS. Bol'shakova, S. I.; Shashkov, A. S.; Degteva, T. G.; Kuz'minskii, A. S. (Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 325-6(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 361-2(Jul-Aug 1971).

Nuclear magnetic resonance was used to investigate the effects of reactions that take place during low-temperature γ radiolysis of butadiene–nitrile rubber on the structure of the material. The magnitude of the second moment of the NMR line was calculated before irradiation, after irradiation, after aging the irradiated sample at a temperature below the γ-transition point (at −78°C), and after thawing to room temperature. Irradiation at −196°C did not affect significantly the magnitude of the second moment of the line. After thawing completely, there is a noticeable change in the shape of the line and an increase in the second moment indicating the formation of an additional number of chemical bonds and compaction of the macromolecules. It is concluded that the chemical activity of the stabilized particles formed during radiolysis governs the final change in polymer structure. (J.G.B.)

14945 EFFECT OF SHOCK WAVES IN TRANSFORMING COLOR CENTERS PRODUCED BY γ-IRRADIATION IN NaCl CRYSTALS. Lapshin, A. I.; Sazonov, L. A.; Batsanov, S. S. (Inst. of Catalysis, Novosibirsk, USSR). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 312-15(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 346-50(Jul-Aug 1971).

A change observed in the yellow–brown coloration of rocksalt crystals, irradiated with ^{60}Co γ rays, to a blue violet coloration when they were subjected to the action of shock waves, is due to association of F-centers to form colloidal particles of metallic sodium in the NaCl lattice. The average size of the colloidal particles formed in this way, as determined by the Mie–Savost'yanova method, is ~400 Å. In polycrystalline samples, as distinct from single crystals, persistence of the F-centers is observed after the explosive action, with their subsequent conversion to colloidal sodium particles by exposure to light or heat. The concentrations of free sodium and chlorine atoms, formed during γ irradiation, were determined. (auth)

14946 RADIOLYSIS OF LIQUID PENTANE, CYCLOHEXANE, AND CERTAIN ALCOHOLS BY MEANS OF AUGER ELECTRONS. Kuzin, V. I.; Filatov, E. S. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 307-11(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 340-5(Jul-Aug 1971).

The formation of alkyl iodides labeled with iodine-125 as a result of the process $^{125}Xe \xrightarrow{e.c.} {}^{125}I$ in pentane, cyclohexane, n-butanol, isobutanol, and isopentanol was studied. The iodides are obtained by a recombination reaction of iodine-125 atoms with radicals formed by means of Auger electrons emitted in the process of electron capture (e.c.). An increase is observed in the yield of fragment alkyl iodides in the presence of electron-accepting additives (I_2, O_2, iso-C_4H_9I) which is explained on the basis of the proposed effect of acceptors, the nature of which differs in the perturbation zone and in the volume. A comparison is carried out of radiation yields G of radicals obtained by calculation with consideration of intermediate radiolysis products, G of radicals found by the iodine method (using the ^{131}I isotope), and radical yields under the effect of Auger electrons. (auth)

14947 PULSED RADIOLYSIS OF POLYMETHYLMETHACRYLATE CONTAINING AROMATIC COMPOUNDS. Borovkova, V. A.; Bagdasar'yan, Kh. S.; Chepel, D. V.; Shemarov, F. V. (Physicochemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 304-6(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 337-9(Jul-Aug 1971).

The formation of ions was studied during the pulsed radiolysis of solutions of triphenylamine, biphenyl, naphthalene in poly(methyl methacrylate) (M) at 300°K. The spectrum obtained in the pure polymer is at least partially due to the captured electrons; in the presence of CCl_4 its optical density decreased. In triphenylamine solutions the cation-radical spectrum of this amine (A^+) appears. The spectra which are obtained in the presence of biphenyl and naphthalene also belong to the cation-radicals of the additions. Thus, for the radiolysis of poly(methyl methacrylate) after a period of time of less than 10^{-6} sec cation-radicals of the addition are formed because of the process $M^+ + A \rightarrow M + A^+$. This process competes effectively with the primary recombination of the matrix charges $M^+ + e^- \rightarrow M$ because of the electron-acceptor properties of the matrix. For this reason the reaction $A^+ + e^- \rightarrow A^*$ takes place slowly. (auth)

14948 KINETICS FOR THE RECOMBINATION OF ACTIVE CENTERS. Belyi, A. A.; Ovchinnikov, A. A. (Physicochemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 299-303(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 331-6(Jul-Aug 1971).

A diffusion-kinetic equation was found for the bimolecular reaction in the presence of nonhomogeneous, initial particle distributions. The results were used to analyze the process for the recombination of active centers in methyltetrahydrofuran irradiated by γ rays. (auth)

14949 INVESTIGATION OF THE REACTIONS OF UNSTABLE PARTICLES BY THE PHOTOEMISSION OF ELECTRONS FROM A METAL INTO NITRATE SOLUTIONS. Eletskii, V. V.; Rotenberg, Z. A.; Pleskov, Yu. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 294-8(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 325-30(Jul-Aug 1971).

A metal electrode in an electrolyte solution that is irradiated with light having a constant quantum energy is a source of solvated electrons. The latter, on reacting with electron acceptors in the solution, give rise to products, especially unstable ones, which, in their turn, may take part in chemical reactions in the bulk of the solution and can also be oxidized or reduced at an electrode. By measuring the photocurrent in the photoemission of electrons from mercury in $NaNO_3$ solution, the kinetic characteristics of the homogeneous and heterogeneous reactions of the unstable particles (NO_3^{2-}) formed by the trapping of hydrated electrons by nitrate ions acting as acceptors were determined. The diffusional problem for the case in which the unstable product formed is partially oxidized at the electrode and partially passes into the bulk of the solution with the formation of a product reduced at the electrode has been solved. The graphical treatment of the curves of the photocurrent on the basis of the results of such a calculation have enabled us to find the transfer coefficient for the oxidation of NO_3^{2-} ($\beta = 0.25$) and the rate constant for the decomposition of NO_3^{2-} in the bulk of the solution ($6 \cdot 10^6$ sec^{-1}). The adsorption of tetrabutylammonium on the mercury retards the oxidation of the NO_3^{2-}. (auth)

14950 INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF ORGANIC DIELECTRICS ON γ-IRRADIATION. Vitokhin, A. D.; Vol'f, E. M. High Energy Chem. (USSR) (Engl. Transl.); 5: No. 4, 290-3(Jul-Aug 1971).

Translated from Khim. Vys. Energ.; 5: No. 4, 321-5(Jul-Aug 1971).

The results are given of an experimental investigation of the temperature dependence of the radiation electric conductivity of thin films of poly(tetrafluoroethylene), polystyrene, poly(ethylene terephthalate), and polycarbonate on intensive ^{60}Co γ- irradiation from 400 to 4500 R/sec in the temperature range −196 to 70°C. A characteristic break is observed on the graph of the temperature dependence at a temperature T′, below which the irradiation electric conductivity is practically constant. The results obtained can be interpreted by means of a model taking into account the recombination of trapped electrons with holes. (auth)

14951 PRIMARY RADIOLYTIC FRAGMENTATION IN TRICAPROIN. LeTellier, Paul R.; Nawar, Wassef W. (Univ. of Massachusetts, Amherst). J. Agr. Food Chem.; 20: No. 1, 129-34(Jan-Feb 1972).

A highly purified triglyceride, tricaproin, was exposed to γ radiation at 6 Mrads and its breakdown products analyzed by gas chromatography, mass spectrometry, and infrared spectrophotometry. The use of such a low-molecular-weight substrate, as a model system, permitted the identification of not only the short-chain fragments reported earlier, but also a number of the corresponding glyceryl residues. The latter group included an ethanediol diester, propanediol diesters, propenediol diesters, diglycerides, and triglycerides. Reaction mechanisms are proposed to explain the formation of these compounds. (auth)

14952 RATE CONSTANT FOR THE INTERACTION OF 2,2,6,6-TETRAMETHYL-4-HYDROXYPIPERIDIN-1-OXY- AND HYDROXY-RADICALS. Skuratova, S. I.; Kozlov, Yu. N.; Zaka-

tova, N. V.; Sharpatyi, V. A. (Inst. of Chemical Physics, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 7, 1035-7(Jul 1971).

Translated from Zh. Fiz. Khim.; 45: No. 7, 1821-3(Jul 1971).

The reaction of the stable nitroxide 2,2,6,6-tetramethyl-4-hydroxypiperidin-1-oxy-radical with ·OH can be used to detect hydroxy radicals in the condensed phase. Hydroxy radicals were generated by the photolysis of hydrogen peroxide solutions or by the radiolysis of water. The rate constant for this reaction was determined. (auth)

14953 ELECTRON PARAMAGNETIC RESONANCE STUDIES ON THE SPATIAL DISTRIBUTION AND STRUCTURE OF TRAPPED ELECTRONS IN GAMMA-IRRADIATED ORGANIC GLASSES. Lin, Ding-Ping. Detroit; Wayne State Univ. (1971). 255p. University Microfilms Order No. 71-29,762.
U Thesis.

Trapped electrons (e_t^-) and trapped radicals were produced by γ-irradiation of glassy 2-methyltetrahydrofuran (MTHF), triethylamine (TEA), and 3-methylpentane (3-MP) at 77°K. The EPR lines of e_t^- in these matrices are inhomogeneously broadened. Spin-lattice relaxation time, T_1, and spin–spin relaxation time, T_2, of both trapped species were obtained by EPR microwave power saturation techniques at 77°K and 4.2°K. The trapped species saturate easier at 4.2°K than at 77°K. The constancy of the spin–spin relaxation time at low radiation doses is attributed to an inhomogeneous spatial distribution, called a "spur," of the trapped species. The spur radius of e_t^- is calculated to be >100Å for 3-MP, ~100Å for TEA, and 63Å for MTHF. For the radicals, the upper limit of the spur radius is 40Å for TEA and 36Å for MTHF. This spur size was related to the polarity of the matrix. The Gaussian line shape and line width of the trapped species remain the same with a temperature change from 77 to 4.2°K. Cross relaxation interactions between e_t^- and R· are indicated from partial optical bleaching effects on the relaxation time of e_t^- in MTHF at 77°K. T_1 is constant at constant temperature if the total spin concentration including e_t^- and R· is considered. An experimental analysis to determine T_1 from fast passage effects on the paramagnetic relaxation of e_t^- in polycrystalline KCl, 10 M NaOH, MTHF, and TEA was carried out. Previous theoretical treatments are generally inapplicable because adiabatic conditions are not easily achieved. A new technique for finding T_1 is proposed. It consists of the phase change of dispersion signal due to the passage effects. The adiabatic rapid but not fast conditions are selected by setting the precalibrated phase sensitive detector at a position 90° out of phase with respect to the modulation field, H_m. Adiabatic fast passage conditions are obtained at the 180° out of phase position. Extrapolate the points in these two regions for the curves of $\chi' H_1$ vs H_1, H_m, or ω_m until they cross each other. The intersection is taken as $\omega_m T_1 = 1$. The wavelength dependence of photobleaching of e_t^- in MTHF was measured at 77 and at 4.2°K to establish the energy level structure of e_t^-. At both temperatures the photobleaching efficiency is low in the region of the absorption maximum, rises near 800 nm, and reaches a maximum bleaching efficiency near 500 nm. The temperature dependence of the bleaching efficiency depends markedly on wavelength; it is about zero at 400 to 600 nm and increases at longer wavelengths. Extrapolation to the long wavelength side of the e_t^- band corresponds to an activation energy of ~0.001 eV for the photobleaching efficiency. These results suggest that a weakly bound excited state exists for e_t^- in MTHF and that direct photoionization to a delocalized state occurs in the high energy tail of the absorption band. (Diss. Abstr. Int., B)

14954 OXIDATION OF HYPOPHOSPHITE TO HYPODIPHOSPHATE BY γ-RAY IRRADIATION. Kobayashi, M.; Takada, J.; Kiso, Y. (Kyoto Univ.). Radiochem. Radioanal. Lett.; 9: No. 2, 63-6(30 Jan 1972).

Experimental evidence is presented to show that, upon irradiation by γ-rays, the oxidation reaction of hypophosphite in aqueous solution proceeds through hypodiphosphate. (auth)

14955 CHEMICAL NATURE OF HYPODIPHOSPHATE PRODUCED BY NEUTRON IRRADIATION OF SODIUM HYPOPHOSPHITE. Kobayashi, M.; Takada, J.; Kiso, Y. (Kyoto Univ.). Radiochem. Radioanal. Lett.; 9: No. 2, 67-75(30 Jan 1972).

Neutron-irradiated sodium hypophosphite yields more than 20% of ^{32}P-labeled hypodiphosphate, P(II)–P(II). In a solution of pH = 1, it is instantly hydrolyzed to hypophosphite and phosphite. The half-life period of the disappearance of P(II)–P(II) assumed to be of the first order is approximately 31.5 hr at pH = 6. In alkaline solutions, P(II)–P(II) gradually disappears through oxidation and disproportionation. According to the electromobility data, the pK_a of the second dissociation is found to be less than five. (auth)

14956 EFFECT OF WATER ON THE YIELDS OF HYDROGEN AND METHANE IN γ-IRRADIATED C_5-HYDROCARBONS. Bryl-Sandelewska, T. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 9: No. 2, 105-12(30 Jan 1972).

The effect of water on the yields of hydrogen and methane in γ-irradiated cyclo-, iso-, and n-pentane was studied. The yields of the investigated products in irradiated two-phase hydrocarbon–water systems (1:1 by volume) are higher than in pure hydrocarbons. A correlation was observed between the increase of the product yields and the mutual solubility of the individual hydrocarbons and water. (auth)

14957 CREATION AND DETECTION OF THE EXCITED STATE. VOLUME I, PART B. Lamola, Angelo A. (ed.). A Series of Monographs. New York; Marcel Dekker, Inc. (1971). 298p. $26.50.

Separate abstracts were prepared for three of the six chapters. The remaining chapters concern vacuum ultraviolet techniques in photochemistry; vacuum techniques in photochemistry; and preparative photochemical instrumentation and methods. (D.H.M.)

For abstracts of individual chapters see: 14958, 14959, and 16156.

14958 IONIZING RADIATION, INSTRUMENTATION, AND METHODS. Johnsen, R. H. (Florida State Univ., Tallahassee). pp 429-80 of Creation and Detection of the Excited State. Vol. I, Pt. B. /Lamola, Angelo A. (ed.). New York; Marcel Dekker, Inc. (1971).

The excited states produced by ionizing radiation are discussed with respect to sources of ionizing radiation, irradiation techniques, dosimetry, mechanisms of energy deposition, energy partition in binary systems, stable product studies as a means of inferring intermediates and mechanisms, and the direct detection and identification of short-lived intermediates. (D.H.M.)

14959 OBSERVATION OF EXCITED STATES BY PULSE RADIOLYSIS. Thomas, J. K. (Argonne National Lab., Ill.). pp 481-502 of Creation and Detection of the Excited State. Vol. I, Pt. B. /Lamola, Angelo A. (ed.). New York; Marcel Dekker, Inc. (1971).

The pulse radiolysis technique, both in the microsecond and nanosecond time ranges, provides an ideal tool for the investigation of excited states. The precise nature of high-energy radiation pulses permits the use of the pulse radiolysis technique to investigate processes that are too short-lived for conventional flash photolysis. The development of nanosecond and picosecond flash photolysis, especially using pulsed lasers as flash sources, should dramatically increase the scope of the photolytic work. Ionizing radiation produces many excited states of high energy, e.g., E_{1u} in benzene, right up to the point of ionization. These states, which are very short-lived, may be observed by future picosecond pulse radiolysis. The formation of ions and subsequent neutralization lead to other interesting modes of formation of excited states. This latter phenomenon is a two-edged sword, as it also leads to complications in radiolysis which do not exist in the lower-energy flash photolysis studies. (auth)

14960 EFFECT OF PHASE ON HOT HYDROGEN ATOM ABSTRACTION REACTION WITH SOLID ISOBUTANE AS STUDIED BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Wakayama, Terunobu; Miyazaki, Tetsuo; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 44: No. 10, 2619-26(Oct 1971).

The effect of phase on the hot-hydrogen-atom abstraction reaction with isobutane at 77°K was studied by electron spin resonance spectroscopy in the photolysis and the γ radiolysis of solid isobutane containing hydrogen iodide. While only the isobutyl radical is formed by the uv-illumination of isobutane–hydrogen iodide systems in the polycrystalline state, the tertiary butyl radical, accompanied with a small amount of isobutyl radicals, is produced from isobutane–methylcyclohexane–hydrogen iodide systems in the glassy state. The hot hydrogen atom produced by dissociative electron attachment to hydrogen iodide abstracts the tertiary hydrogen atom from isobutane at 77°K, independent of whether the matrix is polycrystalline or glassy. It appears that the H-abstraction reaction from isobutane by hot hydrogen atoms depends upon the energy of the hot hydrogen atoms. (auth)

14961 INHIBITION OF POSITRONIUM FORMATION IN AN IRRADIATED ORGANIC SOLID. Hadley, J. H. Jr.; Hsu, F. H. (Georgia State Univ., Atlanta). Chem. Phys. Lett.; 12: No. 2, 291-4(15 Dec 1971).

Positron annihilation lifetime spectra and two gamma angular distributions were measured for DL-leucine before and after γ irradiation. The free radicals produced inhibit the formation of positronium rather than effect its ortho-to-para conversion. (auth)

14962 EXCITED STATES AND REACTIONS IN LIQUIDS. Thomas, J. K. (Argonne National Lab., Ill.). Annu. Rev. Phys. Chem.; 21: 17-38(1970).

Advances and contributions made by new techniques such as lasers and pulsed accelerators to both the mode of production and the understanding of the nature of excited states are reviewed. Excited states in the liquid phase are emphasized, with occasional reference to the gas and solid phases. Topics discussed are techniques, pulsed lasers, short light pulses, pulse radiolysis, singlet excited states, singlet energy transfer, intersystem crossing, triplet states, triplet state of benzene, electron scattering, electrochemiluminescence and the role of ions in forming excited states, excited states in radiolysis, and chemiluminescence. (179 references) (J.G.B.)

14963 GAS-PHASE RADIOLYSIS OF CYCLOPROPANE. Tanaka, Jun-ichi; Hatano, Yoshihiko; Shida, Shoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 44: No. 10, 2860-1(Oct 1971).

The effects of additives, such as SF_6, C_2H_4, C_2H_6, n-C_4H_{10}, n-C_5H_{12}, and C_6H_{12}, on the formation of hydrogen and various hydrocarbon products in the gas-phase γ radiolysis of cyclopropane were examined. The isotopic distribution of propane produced in the radiolysis of two mixtures, c-C_3H_6–3 mole % c-C_3D_{12} and c-C_3H_6–3 mole % c-C_6D_{12}–5 mole % O_2 was also studied. (J.G.B.)

14964 FURTHER STUDY OF THE SCAVENGEABLE ELECTRON YIELD IN THE RADIOLYSIS OF HYDROCARBON GLASSES AT -196°C. Kimura, Toyoaki; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 44: No. 10, 2650-2(Oct 1971).

The yield of scavengeable electrons produced by γ irradiation in mixtures of cyclopentane and methylcyclohexane at –196°C was determined by electron-scavenging experiments with bromobenzene. It was found that the maximum yield of scavengeable electrons in these mixture glasses increases with an increase in the cyclopentane concentration and that it reaches the total ionization yield in a liquid hydrocarbon. The implication of these results for the yield of radioinduced ionization in condensed systems is discussed. (auth)

14965 REACTIONS OF MOBILE ELECTRONS IN THE FROZEN SOLUTION OF ETHYLENE GLYCOL-WATER AT 77°K. Sasaki, Teikichi; Ohno, Shin-ichi (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 44: No. 10, 2626-30(Oct 1971).

The yield of trapped electrons produced in ethylene glycol–water glass at 77°K increased linearly with the gamma dose up to 1.5×10^{20} eV/g, and the G value was estimated to be 2.8 ± 0.2. The relative reaction rates of mobile electrons with various inorganic ions at 77°K were determined by competition kinetics. The observed relative reaction rates with simple inorganic ions corresponded to those of hydrated electrons obtained at room temperature. For complex ions, however, the reactivities of the mobile electrons were larger than those of hydrated electrons. The reaction products, such as bromine dioxide, Cr(V) species, and the pentacyano Co(II) ion, all of which are unstable at room temperature, could be detected by optical and ESR spectroscopies at 77°K. (auth)

14966 THEORETICAL CONSIDERATION OF THE ELECTRON-SCAVENGING PROCESS IN LIQUID HYDROCARBONS. II. PULSE IRRADIATION. Yamazaki, Hideo; Shinsaka, Kyoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 44: No. 10, 2611-15(Oct 1971).

A mathematical treatment of the electron recombination process is presented on the basis of the extended Smoluchowski equation, which includes the effects of several positive ions as ion cores in a spur and of a scavenger. The equation is reduced to the usual Smoluchowski equation for the geminate recombination in a special case. The time dependence of the electron concentration is obtained using a successive approximation. The results of numerical calculations for various reaction parameters are presented. (auth)

14967 PULSE RADIOLYSIS OBSERVATIONS OF SOLVATED ELECTRONS IN LIQUID HYDROCARBONS. Baxendale, J. H.; Bell, C.; Wardman, P. (Univ. of Manchester, Eng.). Chem. Phys. Lett.; 12: No. 2, 347-8(15 Dec 1971).

The absorption spectra of solvated electrons in methylcyclohexane were obtained at –113 and 20°C and the decay kinetics observed. The homogeneous recombinations of electrons and cations in liquid methylcyclohexane and n-hexane at 20°C observed by pulse radiolysis occur with $k = 8 \times 10^{13}$ and 2×10^{14} M^{-1} sec^{-1}, respectively. The reaction of electrons with pyrene and carbon tetrachloride in methylcyclohexane at 20°C have $k = 1 \times 10^{12}$ M^{-1} sec^{-1}. These values are consistent with electron mobilities measured by conductivity. (auth)

14968 IONIC PROCESSES OF γ-IRRADIATED TRIPHENYLAMINE IN 3-METHYLPENTANE GLASS AT 77°K. Sawai, Teruko (Tokyo Metropolitan Isotope Research Center). J. Nucl. Sci. Technol. (Tokyo); 8: No. 12, 685-9(Dec 1971).

The ionic processes of γ-irradiated triphenylamine (TPA) in 3-methylpentane glass (3-MP) were studied. The thermoluminescence curve of the irradiated sample shows two maxima at 77° to 83°K and 83° to 90°K. The effects of differences in radiation dose and of time elapsed after irradiation at 77°K on the luminescence yield of these two peaks were examined. The optical absorptions of trapped electrons (e_t^-), TPA^+ and TPA^- are measured as functions of the storage time at 77°K and of the elevation of temperature. The results for ir and uv bleaching and for prolonged storage at 77°K suggest the presence of negative species other than e_t^- and TPA^-. In the irradiated sample at 77°K in the presence of $10^{-4} \sim 10^{-3}$ M TPA, positive and negative species other than TPA^+ and TPA^- exist and these charges are transferred to TPA to form TPA^+ and TPA^- by warming. These behaviors of the ionic species are discussed. (auth)

14969 EFFECT OF PLATINUM SURFACE ON ^{60}Co GAMMA RADIOLYTIC YIELDS OF FRICKE DOSIMETER. Farhataziz; Iqbal, Mohammad; Chaudhri, Shamim A. (Atomic Energy Centre, Lahore). Nucleus (Karachi); 8: No. 3, 89-94(Jul-Sep 1971).

The presence of a platinum surface activated by heating in air increased the ferric yield for ^{60}Co gamma radiolysis of a Fricke dosimeter. $G(Fe^{3+})$ increased with decreasing dose rate. (auth)

14970 PULSE RADIOLYSIS OF HEXAMETHYLPHOSPHORIC TRIAMIDE. Mal'tsev, E. I.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 2, 379-82(11 Sep 1971). (In Russian).

Irradiation of certain liquids may form short-lived reducing particles, solvated electrons, which may be detected by optical absorption spectra. Spectra of irradiated solutions of NaCl and KCl (10^{-3} mole/l) were compared with solutions of metallic K in hexamethylphosphoric triamide. The dose of the pulse of radiation was about 2×10^{17} eV/ml. The yield of solvated electrons was studied as a function of the concentration of the dissolved salt. Experimental and calculated G values for solvated electrons were found to agree. (K.S.W.)

14971 EFFECT OF ALKALI AND ALCOHOLATE ON THE YIELD OF SOLVATED ELECTRONS FROM PULSE RADIOLYSIS OF METHANOL AND ETHANOL. Pikaev, A. K.; Sibirskaya, G. K.; Shirshov, E. M.; Glazunov, P. Ya.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 2, 383-6(11 Sep 1971). (In Russian).

The optical density of irradiated methanol and ethanol solutions was investigated as a function of the concentration of dissolved KOH and CH_3ONa. The radiation consisted of 5-MeV electrons generated in a linear accelerator pulsed during an interval of about 2.2×10^{-6} sec, using KCNS solution as a dosimeter. The maximum optical absorption bands caused by solvated electrons provided G values that are compared with G values calculated by means of an empirical equation. (K.S.W.)

14972 SOME ASPECTS OF IMPROVEMENT OF PROPERTIES OF CERTAIN FIBERS. Taraporewala, K. S.; Subramanian, R. V. P. (Silk and Arts Silk Mills' Research Association, Bombay). Silk Rayon Ind. India; 14: No. 3, 138-47(Mar 1971).

Chemical as well as radioinduced modifications of certain fibers like cotton, nylon, polyester, and polypropylene were carried out with a view to improve their properties such as crease recovery and moisture absorption. These studies indicated that it is possible to improve the moisture absorption of nylon to the level of cotton fibers. Modified polypropylene is made more easily dyeable: the tensile strength and crease recovery of these fibers are improved by these processes, thus widening the scope of their utility. Radiation grafting was done using γ rays from ^{60}Co and using four monomers, viz., methacrylic acid, acrylamide, a mixture of methacrylic acid and styrene and a mixture of acrylamide and styrene. (INIS)

14973 ELECTRON SPIN RESONANCE STUDIES OF PRIMARY PROCESSES IN RADIATION-INDUCED REACTIONS. IV. EVIDENCE FOR CATION FORMATION IN 1,3-BUTADIENE-1, 1,4,4-d_4 ADSORBED ON SILICA GEL. Shiga, Tetsuo; Lund, Anders; Kinell, Per-Olof (Swedish Research Councils' Lab., Studsvik). Acta Chem. Scand.; 25: 1508-9(1971).

The ESR spectrum following γ-irradiation of 0.1 mole % butadiene on silica gel shows a thermally unstable signal which has been assigned to the cation radical of butadiene. The assignment is supported by the absence of the signal in the presence of triethylamine, which can act as a positive charge scavenger. Strong support is also given by the study of the ESR spectrum following γ-irradiation of butadiene-d_4 on silica gel. (Denmark)

14974 EFFECT OF IONIZING RADIATION ON THE PROPERTIES OF FLUORINE-CONTAINING COPOLYMER LATEX. Mazina, G. R.; Panich, R. M.; Ustinova, Z. M.; (and others)

(Moscow Inst. of Fine Chemical Tech.). Kolloid. Zh.; 33: No. 5, 690-2(Sep-Oct 1971). (In Russian).

The effect of ionizing radiation on the properties of fluorine-containing copolymer latex was studied by using ^{60}Co as a source, the radiation dose ranging from 0.25 to 50 Mrad. The pH of the irradiated copolymer latex became lower, as did the resistance to electrolytes. After irradiation the coagulation threshold of the latex was also lowered with simultaneous coagulation of globules and intraglobular crosslinking of the polymer. Increased radiation dose resulted in greater three-dimensional lattice density. Irradiation of the latex does not lead to formation of intraglobular chemical bonds and to better film formation. (JPRS)

14975 RESOLUTION ENHANCED ESR SPECTRA OF THE TRAPPED ELECTRONS IN AN ALKALINE ICE. Ohno, K.; Takemura, I.; Sohma, J. (Hokkaido Univ., Sapporo). J. Chem. Phys.; 56: No. 3, 1202-6(1 Feb 1972).

The hyperfine coupling constant and the paramagnetic relaxation characteristics of e_t^- in the γ-irradiated NaOH ices annealed at 110°K were studied by resolution enhancement of ESR spectra. The structure of the trapping site was also studied. The resolution of enhanced spectra depends on both the annealing time and the solute concentration, but not on γ-irradiation dose. The solute concentration dependence is discussed by a simple model. (auth)

14976 CHANGES IN POLY(VINYL CHLORIDE) INDUCED BY RADIOACTIVE RADIATION. Kabaivanov, Vladimir; Hadzhidocheva, Sabka (Rubber and Plastics Research Inst., Sofia). Muanyag Gumi; 7: No. 10, 337-42(1970). (In Hungarian).

Emulsified PVC specimens containing a variety of stabilizers were used to determine the modifications induced by exposure to 50 Mrad of radiation from a ^{60}Co source. The tests included determination of the impact strength, tensile strength, molecular weight, and infrared spectrum before and after exposure. The observed splitting off of HCl indicated that the presence of stabilizers improves the thermal stability of the irradiated specimens. Increase of the γ dose decreased the thermal stability. The viscosity of PVC irradiated in the form of powder at 1 Mrad decreased sharply, exhibiting only a slight additional decrease on exposure up to 30 Mrad and no further effect up to 50 Mrad. A similar strong initial effect was observed also in case of the viscosity of specimens containing a variety of stabilizers. The difference between the behavior of solid and powdered specimens was attributed to the influence of oxygen; the solid specimens absorbed much less O. The infrared spectrum of unirradiated specimens had an absorption band at 1600 cm^{-1}, caused by conjugated double bonds; after the γ radiation treatment, the absorption intensity decreased, indicating that the number of these bonds was decreased. The radiation also increased the number of carbonyl groups present, as revealed by absorption at 1725 cm^{-1}. cm^{-1}. The breaking strength and expansion were also found to be reduced by the irradiation. (TTT)

14977 YIELDS OF FREE IONS IN THE X RADIOLYSIS OF SOME SIMPLE SATURATED AND UNSATURATED HYDROCARBON LIQUIDS: EFFECTS OF MOLECULAR STRUCTURE AND TEMPERATURE. Robinson, M. G.; Fuochi, P. G.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 49: No. 22, 3657-64(15 Nov 1971).

Pulse techniques were used at temperatures ranging from 120 to 293°K. A quasifree electron conductance transient (k/u overshoot) was observed in liquid methane, but not in ethane, propane, cyclopropane, ethylene, propylene or butene-1. The free ion yield in methane, G_{fi} = 0.8 at 120°K, is much larger than those in the other liquids, which at 183°K are: ethane, 0.13; propane, 0.076; cyclopropane, 0.04; ethylene, 0.017; propylene, 0.04; butene-1, 0.027. The activation energies of free ion formation are, in kcal/mol: ethane, 0.6; propane, 0.8; ethylene, 0.5; propylene, 1.0; butene-1, 1.0. The results are interpreted in terms of the coulombic interaction model. The distances that the secondary electrons penetrate the liquid away from their parent ions are greater when the hydrocarbon molecules are more sphere-like, and are reduced by the presence of a π bond in the molecule. Cyclopropane behaves somewhat like an olefin in this regard, a fact that is explained by the unusual bonding in the C_3 ring. In the present liquids the only ionization events that contribute appreciably to the free ion yield are those in which the electron penetrates $\gtrsim$100 Å from the parent ion. (auth) (Canada)

14978 ANALYSIS OF PALM OIL AFTER EXPOSURE TO γ-RAYS. 1. QUALITATIVE THIN LAYER CHROMATOGRAPHIC ANALYSIS OF CAROTENES AND CAROTENOIDS AND THEIR PRODUCTS OF RADIOLYSIS. Bancher, E.; Washuettl, J.; Riederer, P. (Technische Hochschule, Vienna). Seifen-Oele-Fette-Wachse; 97: No. 5, 121-4(1971). (In German).

By means of thin layer chromatographic methods the presence and identity of α-, β-, γ-carotene, lycopene, and luteine in non-irradiated palm oil were proved. Vitamin-A_1-alcohol and retene appear as radiolysis products of carotenes after its exposure to γ rays. (orig.) (INIS)

14979 RADIOLYTIC DECOMPOSITION OF CRYSTALLINE INORGANIC SALTS BY RECOIL PARTICLES. V. RADIOLYSIS OF HYDRATED SALTS OF LITHIUM PERCHLORATE IN A NUCLEAR REACTOR. Hasegawa, Kunihiko (Shizuoka Univ., Japan). Nippon Kagaku Zasshi; 92: No. 11, 948-52(Nov 1971). (In Japanese).

The mechanism of radiolysis of ClO_4^- in hydrated lithium perchlorate($LiClO_4 \cdot H_2O$ and $LiClO_4 \cdot 3H_2O$) on irradiation in a nuclear reactor(especially by the recoiled particles from ^6Li (n, α)^3H reaction) or by ^{60}Co γ rays is discussed. The yield of ClO_3^- on reactor irradiation decreased with an increase of water content, whereas the yield of Cl^- increased. The yields of ClO^- and ClO_2^- are practically independent of the water content. An increase of the water content resulted in a decrease of the yields of ClO_3^- and Cl^- and in an increase of the yield of ClO_2^-. It thus can be considered that the radiolysis of this hydrated salt is affected largely by the LET-dependence of yields of radicals(H, OH) and molecular product formed through the radiolysis of the water molecule. The fact that the yield of ClO_3^- decreases with an increasing water content suggests a possibility of the following radiolytically induced back-reaction towards the original species in the solid state: $ClO_3^- + OH \rightarrow ClO_3^0 + OH^-$ and $ClO_3^- + H_2O_2 \rightarrow ClO_4^- + H_2O$. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 14801, 14853, 15726, and 16567.

14980 (CONF-680423–, pp 278-89) MICROACTIVITY RADIOCHEMISTRY. Rodriguez-Pasques, R. H. (National Bureau of Standards, Washington, D. C.).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The problems involved in radiochemical work when the radioactive nuclide concentration is near zero, barely going over the sensitivity threshold of the radiation detector instrument, are considered. Methods for increasing the sensitivity of radiation detection techniques, including minimizing background radiation from electronic, radioactive, and cosmic causes, and radiochemical techniques for low-level samples are discussed. (D.H.M.)

14981 PREPARATION AND PROPERTIES OF RADIOACTIVE CdF_2:$^{169}YbF_3$ SINGLE CRYSTALS. Karelin, V. V.; Molev, G. V.; Izotova, O. E.; Sobolev, B. P. (Moscow State Univ.). Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 4, 727-8(Jan-Feb 1972).

Translated from Kristallografiya; 16: No. 4, 836-7(Jul-Aug 1971).

CdF_2 single crystals activated by inactive Yb and ^{169}Yb were prepared by the Stockbarger technique in an atmosphere of teflon-pyrolysis products and argon. The concentration of $^{169}YbF_3$ was varied from 0.5 to 40 mole %. Autoradiography showed uniform distribution of ^{169}Yb up to 20 mole % inclusive; the solubility limit of YbF_3 lies between 20 and 30 mole %. The saturated solid solution with fluorite structure contains 25 mole % YbF_3, and the parameter is 5.444 Å. The absorption spectra of radioactive and nonradioactive crystals were compared and found to be almost identical; the difference lies in the short-wave doublet. The single crystals luminesce in the yellow-green region with a peak at 520 nm; the radioactive crystals display a characteristic radioluminescence with two peaks at 490 and 540 nm. (D.L.C.)

14982 RADIATION CHEMISTRY OF OXYGENATED AQUEOUS SOLUTIONS. Czapski, Gideon (Carnegie-Mellon Univ., Pittsburgh. Hebrew Univ., Jerusalem). Annu. Rev. Phys. Chem.; 22: 171-208(1971).

The diffusion model for radiation chemistry of aqueous solution and the problems and properties of intermediates found in air-free and air-saturated aqueous solutions are reviewed. Topics covered include: different forms of the reducing radical in aqueous solutions, the hydride ion and dielectrons, the hydroxyl radical, the role of N_2O^-, H_2O_3 and H_2O_4, the ozonide ion radical (O_3^-), the hydroperoxy radical (HO_2), and complexes of HO_2. (174 references) (M.C.G.)

Hot-Atom Chemistry

Refer also to abstract 14960.

14983 (CONF-680423–, pp 225-46) RADIOCHEMICAL APPLICATIONS OF THE MOESSBAUER EFFECT. Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

After a brief review of the Moessbauer effect its applications in the following areas are discussed: radiolysis of solids, recoil chemistry, surface studies, microcrystals, ion exchange resins, and solutions. The possibility of using Moessbauer effects to study the chemistry and solid state properties of the heaviest elements is also considered. (D.H.M.)

14984 (CONF-680423–, pp 247-51) DISTRIBUTION OF THE RADIOACTIVE ANTIMONY FORMED BY NEUTRON CAPTURE IN THIOCOMPOUNDS OF ANTIMONY. Facetti, J. F.; Colman, H. D.; Molinas, E.; Vallejos, A. (Asuncion Univ. (Paraguay). Instituto de Ciencias). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The distribution of the oxidation stage (III) and (V) in Sb_2S_3, Sb_2S_5, $(NH_4)_3SbS_3$, and $Na_3SbS_4 \cdot 9H_2O$ was studied. The results are tabulated. They show that the yields of the pentavalent stage in the thio compounds are higher than those obtained in the oxides and antimonates. No linear relation existed between the sulfur contents and the Sb(V) yield. (J.S.R.)

14985 (CONF-680423–, pp 275-7) NEUTRON IRRADIATION OF BROMOBENZENE AND ITS DERIVATIVES. Mateos, Enrique Parra (Comision Nacional de Energia Nuclear, Mexico City).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The chemical effects accompanying neutron irradiation of bromobenzene and nitro derivatives of bromobenzene were studied. The retention of ^{80}Br (%) and ^{82}Br (%) in bromobenzene, o-nitrobromobenzene, p-nitrobromobenzene, and 1-bromo-2,4-dinitrobenzene was 50, 35, 36, and 36 for ^{80}Br and 80, 62, 50, and 82 for ^{82}Br, respectively. (D.H.M.)

14986 (FRNC-TH-128) CHEMICAL EFFECTS OF THE $^{127}I(n,\gamma)^{128}I$ REACTION IN IODINE–n-BUTANE MIXTURES. Lagarde, Gerard (Strasbourg Univ. (France)). 1971. 67p. (In French). Dep. NTIS (U. S. Sales Only).

A study of the chemical effects associated with the $^{127}I(n,\gamma)^{128}I$ nuclear reaction in an iodine–n-butane mixture, in the gaseous or liquid phase, enabled the importance of the reactions leading to organic iodides, and an important phase effect, to be demonstrated. In the gaseous phase, the organic yield is small (2.04% for a pressure of 700 Torr and an iodine molar fraction of 9×10^{-3}). The hot reactions lead to the formation of CH_2I_2, CH_3I, C_2H_5I, C_2H_3I, n-C_3H_7I and s-$C_3H_{11}I$. The effects of Ar, Kr, and Xe on the organic yields are given. In the liquid phase an enhanced organic yield (26% for an iodine molar fraction of 0.003) and the predominance of the iodobutane formed, are explained in terms of the self-irradiation hypothesis associated with the collision model. This study demonstrates the importance of decomposition reactions with primary iodides by collisions, particularly in the gaseous phase. (France)

14987 CHEMICAL EFFECTS OF NUCLEAR REACTIONS IN DOPED COMPOUNDS. III. POTASSIUM CHROMATE DOPED WITH PHOSPHATE. Costea, T.; Negoescu, Irina; Podeanu, Georgeta (Institut de Physique Atomique, Bucharest). Radiochim. Acta; 16: No. 2, 86-91(Nov 1971). (In French).

In studying thermal annealing in pure and phosphate-doped K_2CrO_4, it was observed that the greater the dopant concentration, the smaller the annealing degree and the activation energy. A comparison between the effects of the doping with an anion–electron donor (PO_4^{3-}) and a cation–electron acceptor (La^{3+}) on the annealing processes was also done. It was concluded that the model of the electronic transitions leads to mechanisms compatible with the phenomenology and the kinetics of recoil atoms in La^{3+} or PO_4^{3-} doped K_2CrO_4. (auth)

14988 CHEMICAL EFFECTS OF NUCLEAR REACTIONS IN DOPED COMPOUNDS. IV. LANTHANUM CHROMATE DOPED WITH BARIUM AND POTASSIUM. Costea, T.; Negoescu, Irina; Podeanu, Georgeta (Institut de Physique Atomique, Bucharest). Radiochim. Acta; 16: No. 2, 91-3(Nov 1971). (In French).

The doping of $La_2(CrO_4)_3$ with Ba^{2+} or K^+ has no influence on initial retention and on thermal annealing of recoil atoms. The conclusion that the doping does not alter the concentration of charge carriers was drawn. The atomic defects (impurities and vacancies) have no role in the annealing processes if the associated levels do not participate in electronic transitions, which produce additional charge carriers. (auth)

14989 FORMATION OF OCSe FROM THE REACTION OF RECOIL SELENIUM ATOMS WITH CARBON MONOXIDE. Baldwin, R. S.; Proto, D. O.; Church, L. B. (State Univ. of New York, Buffalo). Radiochim. Acta; 16: No. 2, 94-6(Nov 1971).

Recoil ^{83}Se atoms resulting from the thermal-neutron-induced fission of ^{235}U reacted in the gas phase with carbon monoxide. $OC^{83}Se$ was isolated and identified as a reaction product present in low yields. The reaction of these same recoil selenium atoms with CO_2 did not produce any $OC^{83}Se$, nor did (n,γ) produced ^{75}Se atoms react with CO to form $OC^{75}Se$. These low yields are in direct contrast to similar work that studied the chemical reactions of recoiling ^{35}S atoms. (auth)

14990 ELECTRONEGATIVITY EFFECTS IN T-FOR-CH_2X SUBSTITUTIONS FOR RECOIL TRITIUM REACTIONS WITH n-PROPYL FLUORIDE. Small, Thomas; Arezzo, Bartyra; Rowland, F. S. (Univ. of California, Irvine). Contract AT(04-3)-34. J. Phys. Chem.; 76: No. 2, 187-9(20 Jan 1972).

The relative yields for the substitution of energetic T atoms for heavy substituents were compared in the n-C_3H_7F system. Formation of CH_2TF is only 0.80 (+0.05, –0.15) as likely as of CH_3CH_2T, after correction for secondary decomposition of both products. The lower yield for CH_2TF is attributed to an electron-withdrawal effect of the F atom, thereby hindering successful formation of the new C–T bond. Rotational inertia effects should be negligible in such a comparison because of the near-equivalence of F and CH_3 in such inertial properties. (auth)

14991 HOT-ATOM CHEMISTRY OF ^{82}Br ATOMS IN PENTAMMINECOBALT(III) BROMIDES. Tominaga, Takeshi; Ishii, Masao; Saito, Nobufusa (Tokyo Univ.). Radioisotopes (Tokyo); 20: No. 11, 579-81(Nov 1971).

Eight cobaltammine bromides, $[Co(NH_3)_5X]Br_{1-3}$ (X = NH_3, H_2O, halogens, etc.) were irradiated with thermal neutrons at dry ice temperature in a TRIGA reactor. The chemical distribution of ^{82}Br atoms arising from $^{81}Br(n,\gamma)^{82}Br$ and $^{81}Br(n,\gamma)^{82m}Br(IT)^{82}Br$ transformations was determined by means of an ion exchange method. Since the ^{82}Br ligand yields (the percentages of total produced ^{82}Br complexed with cobalt) obtained experimentally were the overall yields from the composite effects of the above transformations, the ^{82}Br ligand yields from $^{82m}Br(IT)^{82}Br$ recoil reactions alone were estimated by making adequate assumptions. The estimated ^{82}Br ligand yields from $^{82m}Br(IT)^{82}Br$ reaction were found to vary with the kind of ligand, X, in the target complexes. The correlation appears to be similar to that observed with $^{80m}Br(IT)^{80}Br$ reaction. (auth)

14992 TRANSFER AND EXCHANGE OF TRIVALENT CHROMIUM IN SOLIDS. Mahieu, B.; Apers, D. J.; Capron, P. C. (Univ., Louvain, Belg.). Radiochim. Acta; 16: No. 2, 100-3 (Nov 1971).

It is suggested that the increase of retention on annealing above 100°C in neutron-irradiated chromates may be explained by a solid-state transfer mechanism. A re-orientation of the oxygen bonds around the intruder chromium can alter the oxidation state of the latter. Also in a potassium sulfate matrix doped with Cr(III), chromate ions are formed on heating. (auth)

14993 INFLUENCE OF IRRADIATION AND PREIRRADIATION ON THE DISTRIBUTION OF RADIOACTIVE ARSENIC IN COMPOUNDS OF ARSENIC, SELENIUM, AND GERMANIUM. Virsoo, Maela Tea (Comision Nacional de Energia Atomica, Buenos Aires). Rev. Soc. Cient. Paraguay; 11: No. 1-2, 1-7 (1970). (In Spanish).

The effects of irradiation conditions, pre-irradiation, and dissolution media on the chemical fate of radioactive arsenic, selenium, and germanium compounds were studied. The gamma doses during or a very short time after irradiation and the water content of the molecule, affect the yields of the different arsenic fractions. No influence was observed due to the pH conditions of the dissolution media. These results confirm that the new species reached their final state immediately after irradiation. (auth)

14994 MOESSBAUER SPECTROSCOPIC STUDIES OF THE OXIDATION STATE OF ^{57}Fe PRODUCED IN ^{57}Co-DOPED AND γ-IRRADIATED TRISACETYLACETONATOIRON(III). Sano, Hirotoshi; Sato, Keiko; Iwagami, Hiroko (Ochanomizu Univ., Tokyo). Bull. Chem. Soc. Jap.; 44: No. 9, 2570-1(Sep 1971).

The Moessbauer spectra of the first excited state of ^{57}Fe produced in an iron tris(acetylacetonate) host crystal doped with ^{57}Co and of γ-irradiated iron(trisacetylacetonate) are shown. Both samples showed the same Moessbauer pattern. (M.C.G.)

14995 RECOIL EMANATING POWER OF PARTICLES ISOLATED FROM FINELY DIVIDED SOLIDS. Quet, C.; Rosseau-Violet, J.; Bussiere, P. (Institut de Recherches sur la Catalyse,

Villeurbanne, France). Radiochem. Radioanal. Lett.; 9: No. 1, 9-18(15 Jan 1972). (In French).

The recoil fraction of the emanating power was calculated for single solid particles with various shapes involving at least one dimension comparable to or smaller than the recoil range. A comparison of the theoretical values derived with experimental emanating powers at room temperature for finely dispersed solids illustrates the dependence of this characteristic on the rapid diffusion through the damaged regions of the solid where the gaseous recoiling atoms are stopped. (auth)

14996 MOESSBAUER STUDY OF IRRADIATED IRON CHELATES AND CHEMICAL CONSEQUENCES OF ^{57}Co ELECTRON CAPTURE IN COMPLEX LIGAND COMPOUNDS. Baggio-Saitovitch, E.; Friedt, J. M.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 16: No. 19, 279-97(1971).

Iron complexes were irradiated with 2-MeV electrons at 160°C to a total dose of about 1800 Mrad. Moessbauer spectra were measured and results indicated that the species stabilized after ^{57}Co electron capture decay are similar to those formed by radiolysis. (M.C.G.)

14997 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS IN SOME TELLURIUM COMPOUNDS. Warren, John Lawrence. Burnaby, B. C.; Simon Fraser Univ. (1970). National Library of Canada, Ottawa.

Thesis.

The chemical effects of several different nuclear transformations were studied in solid tellurium compounds using both standard radiochemical techniques and Mössbauer spectroscopy with ^{129}I. In the radiochemical investigation, a comparative study was made in telluric acid, H_6TeO_6, of the molecular fragmentation accompanying the ^{130}Te(n,γ)^{131}Te $\xrightarrow{\beta^-}$ ^{131}I process and the β^--decay of ^{131m}Te, ^{131}Te, and ^{132}Te. The chemistry of ^{129}Te recoil atoms formed in the ^{128}Te(n,γ)^{129}Te nuclear reaction and the decay of ^{129m}Te in telluric acid were also investigated. In each instance the thermal annealing reactions of the recoil fragments in the solid were investigated. The study of the radioactive decay of ^{131m}Te, ^{131}Te, ^{132}Te, and ^{129m}Te in labeled samples was of particular importance. These isotopes differ in the degrees of electronic excitation and ionization accompanying their decay. Thus it was of interest to see if such differences would lead to different patterns of molecular fragmentation or to differences in the subsequent annealing reactions of the recoil fragments. It was found that the ^{131}I and ^{132}I recoil atoms formed in the decay of the first three isotopes were present in the same chemical forms (I^-, IO_3^-, and IO_4^-) but in differing yields. Differences were also observed in the thermal annealing reactions in these samples, which may be interpreted in terms of the different processes accompanying the decays. It was found that the ^{129}Te atoms born in the isomeric transition decay of ^{129m}Te are similar in their annealing behavior to the ^{132}I atoms born in the decay of ^{132}Te. Both of these decay processes are accompanied by large degrees of internal conversion of γ transitions, which leads to qualitatively similar annealing reactions of the daughter recoil atoms. The trends observed in the recoil product distributions and the annealing reactions are discussed in terms of the difference in the nuclear transformations producing the recoil atoms. The Mössbauer experiments allowed study of the recoil atoms in situ in the solid and thus provided a much more detailed picture of the chemical effects of nuclear transformations. The chemical effects of the decay of ^{129}Te $\xrightarrow{\beta^-}$ ^{129}I were studied in telluric acid, $(H_2TeO_4)_n$, α-TeO_3, tetragonal TeO_2, and H_2TeO_3 using the 27.7 keV, 16.8 nanosecond Mössbauer transition in ^{129}I to provide information about the chemical form of the iodine atom produced. These experiments were performed with a standard Na^{129}I absorber and with the source and absorber at liquid nitrogen or liquid helium temperatures. No chemical effects of the β^- decay were observed in any of the above compounds, the iodine atom remaining bonded to the ligands of the precursor tellurium molecules. These results are in sharp contrast to the findings of radiochemical experiments. Studies were made of the ^{129m}Te $\rightarrow$ ^{129}Te isomeric transition in ^{129m}Te-labeled compounds using the ^{129}I Mössbauer spectrum to provide information about the chemical form of the ^{129}Te atoms formed in the decay. Molecular fragmentation was observed to accompany the decay in a considerable fraction of events in H_6TeO_6 and $(H_2TeO_4)_n$ with the formation of the TeO_3^{2-} ion as the sole decomposition product. The ^{128}Te(n,γ)^{129}Te nuclear reaction was found to produce the same decomposition in H_6TeO_6. The thermal annealing reactions of the isomeric transition and (n,γ) recoil atoms were also studied and found to lead to a simple, single-step reaction, $TeO_3^{2-} \rightarrow$ Te(VI). In addition, Mössbauer work provided several pieces of information concerning bonding and structure in these tellurium compounds and allowed the determination of several constants of general interest in ^{125}Te and ^{129}I Mössbauer studies. The results of the Mössbauer work are compared and contrasted with those of the radiochemical study. (Diss. Abstr. Int., B)

14998 REACTIONS OF RECOIL ^{13}N AND ^{32}P IN THE GAS PHASE. Stewart, Gerald Walter. Moscow, Idaho; Univ. of Idaho (1971). 79p. University Microfilms Order No. 72-2116.

Thesis.

Recoil reactions of ^{13}N in CO_2, N_2, O_2, N_2O, and NO were studied. Recoil nitrogen atoms were generated by the ^{12}C(d,n)^{13}N reaction using CO_2 as the target molecule. The most likely states for the ^{13}N atom are the ^{4}S, ^{2}D, and ^{2}P. The population of these electronic states are 48% N(^{2}P), 24% N(^{2}D), and 28% N(^{4}S). ^{2}D and ^{2}P are the major reactive nitrogen atom species, whereas, ^{4}S is observed to react only with nitric oxide. The other reactive species present is the vibrationally excited nitrogen molecule. In CO_2 the major products are ^{13}NN (82%) and ^{13}NNO (18%). ^{13}NN is formed by ^{13}N atoms reacting with nitrogen impurities, whereas, ^{13}NNO is formed by excited nitrogen molecules reacting with impurities of oxygen. Indirect evidence is given for ^{13}NN formation by a hot atom reaction when C_2H_4 is used as a scavenger. A flow system is also described which provides for the continuous irradiation of a gas stream with a 2 MeV Van de Graaff accelerator. The fractionation and analysis of the irradiated gas stream by means of radiogas chromatography is described in detail. Effective thresholds for the production of ^{13}N and ^{15}O in this system are 1.15 and 1.7 MeV, respectively. The chemical behavior of recoil ^{32}P atoms in PH_3 and PF_3 was studied in order to determine the general feasibility of extending hot atom investigations to phosphorus. Recoil phosphorus was generated by the ^{31}P(n,γ)^{32}P reaction. $^{32}PH_3$ and $^{32}PF_3$ were the only volatile products observed in phosphorus atom reactions with PH_3 and PF_3. $^{32}PH_3$ was observed as a reaction product with H_2. An upper limit of 0.1% was established for primary retention in PF_3. Scavenger studies were performed on PF_3 and a moderator study was made on a PH_3-PF_3 mixture. Sixty per cent of the $^{32}PH_3$ yield appears to result from hot phosphorus atoms and 40% from thermal atoms. A plausible reaction mechanism for the production of $^{32}PH_3$ and $^{32}PF_3$ is discussed. (Diss. Abstr. Int. B)

14999 RECOIL TRITIUM REACTIONS WITH METHYLSILANES. Hosaka, Akio. Irvine, Calif.; Univ. of California (1971). 197p. University Microfilms Order No. 72,2239.

Thesis.

Recoil tritium reactions with methylsilanes and partially deuterated methylsilanes in which the Si–H bonds are deuterium substituted were studied to examine the reactivity difference of C–H and Si–H bonds. The corresponding hydrocarbons were used for comparison. The principal hot products in these reactions are HT(DT), CH_3T, parent-t, and the product corresponding to the replacement of CH_3 by T, as expected from the results of hydrocarbon systems. A higher reactivity of methylsilanes was generally observed in both abstraction and substitution reactions. Oxygen scavenger studies on the hydrogen abstraction reactions, using partially deuterated methylsilanes, showed that while the yield of HT relative to parent-t was constant with O_2, the yield of DT decreased slowly with increasing O_2 concentration. In addition, the yield of DT per bond was much higher than that of HT. These results suggest a very low threshold energy for the abstraction reaction from the Si–H or Si–D bonds, and indicate that the distinction between hot and thermal reactions is difficult to define experimentally with these bonds. Direct comparison of abstraction yields from the corresponding C–D and Si–D bonds of partially deuterated skeletal compounds was performed using an excess of ethylene or nitrogen moderator. The DT yields from Si–D bonds of methylsilanes were far greater than the DT yields from C–D bonds of the corresponding hydrocarbons. Using available bond-dissociation energy values, the DT yields from $(CH_3)_3$Si–D fits the extrapolation of the correlation curve of the DT yield with C–D bond-dissociation energy obtained from partially deuterated hydrocarbons. These greater abstraction yields from Si–D bonds are related to the weak bond-dissociation energy of the Si–D bonds. On the other hand, the observed lower HT yields from the methyl groups in tri and tetramethylsilanes relative to yields in hydrocarbons suggest a stronger bond-dissociation energy of C–H bonds, (~101 Kcal) in methylsilanes than in the corresponding hydrocarbons. Intermolecular competitions of the T-for-H substitution reaction between methylsilanes and the corresponding hydrocarbons were compared. The relative parent-t activity ratios were: $(CH_3)_4Si/(CH_3)_4C = 1.22$; $(CH_3)_3SiH/(CH_3)_3CH = 1.35$; $(CH_3)_2SiH_2/(CH_3)_2CH_2 = 1.61$; $CH_3SiH_3/CH_3CH_3 = 2.04$. Comparisons were also obtained by determining the intramolecular distributions of tritium between the C–H and Si–H(D) bonds in trimethylsilanes. The yield of T-for-H substitution per bond at the Si–H position was found to be 1.91 ± 0.10 times greater than that at the C–H position in $(CH_3)_3SiH$. This value was essentially the same at different gas pressures and in the liquid phase. The comparison

of T-for-H substitution showed no appreciable difference between highly moderated systems and nonmoderated systems in intermolecular and intramolecular competitions, indicating that the average reaction energy is nearly the same in both systems. The primary isotope effect of T-for-H vs T-For-D substitution reaction in $(CH_3)_3SiH$ vs $(CH_3)_3SiD$ was measured as 1.38 ± 0.08, consistent with the values obtained in several hydrocarbons. In contrast to hydrocarbon systems which show decreasing CH_3T yields per CH_3 group from neopentane to ethane, the CH_3T yield per CH_3 group from methylsilanes increases with decreasing numbers of CH_3 groups. A short-lived intermediate for T-for-H substitution and CH_3T formation was postulated to explain the observed isotope effect and CH_3T yield. The possibility of involvement of the silicon d-orbitals in the formation of this intermediate is discussed. (Diss. Abstr. Int., B)

Properties of Radioactive Materials

Refer also to abstracts 14784, 14785, 16894, and 16905.

15000 (CONF-680423–, pp 135-9) MECHANISM OF DISSOLUTION OF URANIUM OXIDES IN ACETIC MEDIUM. Lara, Jacobo Gomez; Severiano, Gaspar Camarena (Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Quimica). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The kinetics of the dissolution of U_3O_8 in the presence of acetate ions were studied with the purpose of establishing the mechanism of the process and of comparing the data with data obtained previously. The dissolution times at various redox potentials and Fe^{3+} concentrations were determined. The preliminary results are given graphically. (J.S.R.)

15001 (CONF-680423–, pp 152-9) PREPARATION OF TRANSURANIC ELEMENTS. Seelmann-Eggebert, W. (Kernforschungszentrum, Karlsruhe (West Germany)). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The history of the discovery of the transuranic elements and a brief tabulation of them are presented. The transuranic elements are obtained by irradiation with heavy ions or by successive capture of neutrons. The neutron-deficient nuclides can be obtained only by fusion of two nuclei. The experiments leading to the discovery of elements 104 and 105 at Dubna are summarized. Chemical tests with the activity with half-life of 0.3 sec are discussed. Multiple capture in a dense neutron flux of very short duration and successive capture of neutrons in long-duration irradiations are considered. The preparation of measurable quantities is described. Future designs for preparation of additional nuclides and superheavy elements are briefly considered. (J.S.R.)

15002 (JINR–P7-6153) EXPERIMENTS (JINR, DUBNA) ON SYNTHESIS AND SEARCH FOR TRANSURANIUM ELEMENTS IN NATURE. Flerov, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

Work conducted at the Laboratory of Nuclear Reactions (JINR) on synthesis and search for transuranium elements in nature is reviewed. The work on synthesis of elements 102 to 105, and new types of radioactivity, discovered at the laboratory, are discussed. The prospects of the search for superheavy elements in nature are considered. (auth)

15003 (KFK–1416) COMPOUNDS OF TRIVALENT TRANSURANIUM COMPOUNDS APPEARING IN MIXTURES OF COMPLEXING AGENTS. Moattar, Faramarz (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jun 1971. 39p. (In German). Dep. NTIS (U. S. Sales Only).

The complexes of trivalent americium and curium occurring in mixtures of aminopolycarboxylic acids (H_NL) and hydroxycarboxylic acids (HA) were investigated. Besides the "normal" complexes ML_j and MA_j, there are mixed complexes of the general composition $MLA \cdot aq$ with M = Am, Cm; L = aminopolycarboxylic acid (e.g., H_4ADTE) and A = hydroxycarboxylic acid (e.g., glycolic acid, citric acid), the stability constants of which are about $^1/_{10}$ of those of the simple complexes ML. So it is proved that, in separation of trivalent actinide and lanthanide ions by mixtures of complexing agents (e.g., in the Talspeak process), mixed complexes are taking part, and that an estimation of the separation factors or of the two-phase distribution coefficients on the basis of the "simple" complexes only are not acceptable. (auth)

15004 (NP–19150) KINETICS AND MECHANISM OF HYDROGEN REDUCTION OF SOME URANIUM OXIDES. Juusela, Jyrki (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Process Metallurgy). 1971. 53p. Dep. NTIS (U. S. Sales Only). Thesis.

Hydrogen reductions were carried out on two types of U_3O_8 powders and four powder fractions. Kinetics and mechanism of reduction of solid U_3O_8 and UO_2 were studied. A method was developed to produce dense bodies of U_3O_8 with high oxygen content (O/U = 2.65). Activation energies for powders (Q_{active} = 32 kcal/mole, and $Q_{inactive}$ = 28 kcal/mole) were determined and they were related to the reduction of the UO_2^+ phase because of fast nucleation rates in powders. The parabolic law found with active U_3O_8 cannot be used as any indication of the mechanism. The rate of reaction with powder fractions and inactive U_3O_8 was found to obey a linear law. A linear relationship between specific surface areas and rate constants was determined for the fractions ($k_1^1 = 0.096 \cdot S + 0.33$). The rate of reaction per unit area was greater with inactive U_3O_8 than with active due to different values of p_{H_2} inside the samples caused by different surface characteristics of powders. Reduction of solid U_3O_8 was found to obey the Avrami–Erofeev equation (α = fraction reacted = $1 - e^{-kn^t}$) with the value $n \approx 3$. At the beginning of the solid U_3O_8 reduction a linear law was found, and it was related to the nucleation and undisturbed growth of nuclei. Reduction of solid U_3O_8 proceeded through the formation of a UO_2^+ phase on the initial and crack-generated surfaces. An activation energy of Q = 16 kcal/mole was found for the linear part, and Q = 22 kcal/mole for the rest of the reaction. The former indicates the nucleation and the growth of nuclei and the latter a mixed control of nucleation and reduction of the UO_2^+ phase. This was verified by the formation of $UO_{2.22}$ and the rapid reduction of it compared to whole reduction time on the initial surface of the sample. In the reduction of UO_2 (O/U = 2.22) a diffusion controlled reaction was found with 100% hydrogen composition, the activation energy of which was Q = 30 kcal/mole. Temperature dependence of diffusion coefficient was, for the range T = 812 to 920°C, D = 0.15 exp (–30000/RT) cm^2/s. Parabolic rate laws were also found with lower partial pressures of hydrogen, in reduction of solid $UO_{2.22}$, but the decrease of reaction rate with decreasing hydrogen pressure indicated the rate-limiting step to be the surface phenomena. (auth) (Finland)

15005 (RDT-E–13-3-T(6-71)) FAST FLUX TEST FACILITY URANYL NITRATE SOLUTION. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1971. 13p. RSO.

Requirements were established for uranyl nitrate solution to be used for production of mixed oxide fuel pellets for FFTF driver fuel pins. The preparation procedure, impurity limits, quality assurance provisions, and preparation for delivery are discussed. (M.C.G.)

15006 (RDT-E–13-4-T(7-71)) FAST FLUX TEST FACILITY PLUTONIUM NITRATE SOLUTION. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1971. 13p. RSO.

Requirements are established for plutonium nitrate solution to be used for fabrication of mixed oxide fuel pellets for FFTF driver fuel pin. The production process, impurity limits, quality assurance provisions, and preparation for delivery are discussed. (M.C.G.)

15007 (RFP–1760) ALKALI METAL CARBONATES OF PLUTONIUM. Navratil, James D. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 20 Dec 1971. Contract AT(29-1)-1106. 20p. Dep. NTIS.

Preliminary identification and characterization of compounds precipitated from plutonyl(VI), plutonium(IV), and plutonium(III) solutions upon alkali metal carbonate addition is reported. Various precipitation conditions and precipitate-washing solvents were tried. Plutonyl(VI) carbonate was precipitated at pH 4 to 7 regardless of the alkali metal carbonate. Further addition of carbonate solution to the PuO_2CO_3 precipitate and supernate gave soluble green solutions and a residue of major composition $MPuO_2CO_3$, where M = K, Rb, and Cs. Ethanol salting out of the soluble complex gave precipitates of composition $M_4[PuO_2(CO_3)_3]$, (M = Li, Na, K), and $M_6[(PuO_2)_2(CO_3)_5]$, (M = Rb, Cs). The plutonium(IV) and (III) systems appeared to yield impure $Pu(OH)_4$ (or hydrated PuO_2) and $PuOCO_3$, and $Pu_2(CO_3)_3$, respectively, regardless of the alkali metal carbonate used. The compounds were characterized by electronic and infrared spectrophotometry, thermogravimetric analysis, and x-ray diffraction techniques. (auth)

15008 NEW SYNTHESIS FOR THE PREPARATION OF ^{14}C-LABELLED ALKALI CYANIDES. Banfi, D.; Mlinko, S.; Palagyi, T. (Magyar Tudomanyos Akademia, Budapest). J. Label. Compounds; 7: No. 3, 221-3(1971).

A convenient gas catalytic process was developed for the synthe-

sis of radioactive alkali metal cyanides on a micro or semimicro scale. The carbon content of the barium carbonate used as starting material can be quantitatively transformed into potassium cyanide by a simple process. (auth) (Belgium)

15009 STUDIES OF THE BEHAVIORS OF CARRIER-FREE RADIOISOTOPES. V. RADIOCOLLOIDAL BEHAVIORS OF CADMIUM IN AQUEOUS SOLUTION. Ichikawa, F.; Sato, T. (Japan Atomic Energy Research Inst., Tokai). Radiochim. Acta; 16: No. 2, 78-80(Nov 1971).

Behavior of radiocolloidal cadmium in extremely low concentration was studied by high-speed centrifugation, adsorption, and ion exchange methods. Cadmium adsorbs on the surface of polyethylene from neutral solution of low cadmium concentration. It behaves as a colloid in weak alkali solution. In the solution of pH value about 12, cadmium hydroxide begins to precipitate: the amount of the precipitate increases, passing a maximum with further increase of pH, and then it dissolves in a sufficiently concentrated alkali solution with the formation of anionic species. (auth)

15010 BEHAVIOUR OF CARRIER-FREE ^{32}P TOWARDS ADSORPTION CHARACTERISTICS OF CERTAIN FRESHLY PRECIPITATED IONIC SOLIDS. Bhutani, M. M. (Indian Inst. of Tech., Delhi). Radiochim. Acta; 16: No. 2, 81-5(Nov 1971).

Deposition of carrier-free radioactive orthophosphate ions, $^{32}PO_4^{3-}$, on freshly precipitated $PbSO_4$, $PbCrO_4$, and $BaCrO_4$ was investigated. The influence of (i) pH of the suspension medium, (ii) certain lattice and non-lattice ions, (iii) age of the carrier, and (iv) extraction of the carried activity on the deposition process was examined. The results indicate that the deposition process is due to surface adsorption, most probably by a counter ion exchange mechanism. The carrying on fresh $PbSO_4$ is adversely affected in the presence of non-lattice cations (e.g., Ba^{2+} and Sr^{2+}), whereas it is helped on fresh $PbCrO_4$ and $BaCrO_4$ under similar circumstances. The observed decrease in the carrying with increasing age of the carrier is considered to be due to surface contraction of the aging precipitate. The extraction study of the activity adsorbed on carriers under different experimental conditions indicates that, while with ignited carriers deposition takes place on the exposed surface, in freshly formed precipitates the tracer is mainly entrapped in internal capillaries. (auth)

15011 COMPOSITION, FORMATION, AND LUMINESCENCE OF THORIUM(IV) 8-QUINOLINOL AND RUTHENIUM-IMINE CHELATES. White, Gordon M. Bethlehem, Pa.; Lehigh Univ. (1971). 108p. University Microfilms Order No. 71-27,747.

Thesis.

The luminescence of tetrakis(8-quinolinolato)thorium(IV) and several 1,10-phenanthroline ruthenium(II)-chelates was investigated. The orange thorium(IV) 8-quinolinol material precipitated from slightly acidic aqueous solution is shown to be a nonstoichiometric mixture of tetrakis (8-quinolinolato)thorium(IV), ThQ_4, and 8-quinolinol, HQ, with the approximate composition $ThQ_4 \cdot 0.6HQ$; previously the 1 : 1 adduct, $ThQ_4 \cdot HQ$, had been the accepted composition. The near-ultraviolet absorption spectrum of absolute ethanol solutions of the 4 : 1 chelate, ThQ_4, indicates that the compound is unstable in solution and extensive dissociation occurs. Its fourth stepwise formation constant, K_4, is approximately 10^{10}. The effect of ligand field strength on charge transfer luminescence of several bis(1,10-phenanthroline) ruthenium(II) chelates was investigated. The luminescence (or lack thereof) from these chelates appears related directly to the strength of the ligand field. The luminescence intensity of those complexes which are luminescent in fluid solution is very sensitive to the sample temperature. These observations are explained in terms of excited state spin crossover between the low- and high-spin charge transfer excited state configurations (π^*, t_{2g}^5) and ($\pi^*, e^2 t_{2g}^3$). Investigation of the formation of tris(1,10-phenanthroline) ruthenium(II) when a solution of Ru(III) and 1,10-phenanthroline are heated together at pH2 suggests the first species formed are bridged diols. The rate of appearance of the final product, $[Ru(II)(phen)_3]^{2+}$, is equal to the rate of appearance of ruthenium(II)-phen species. (Diss. Abstr. Int., B)

15012 COMPLEXES OF PHENYLARSONIC ACIDS WITH URANIUM(IV). Sandhu, S. S.; Aulakh, G. S. (Panjabi Univ., Patiala, India). Indian J. Chem.; 9: No. 7, 721-2(Jul 1971).

Uranium(IV) forms green-colored complexes (mp > 300°) with a number of phenylarsonic acids. IR data of the complexes reveal the replacement of protons of phenylarsonic acid group by U(IV). The magnetic moment values are slightly less than those calculated on the basis of two unpaired electrons. (auth)

15013 COMPUTATION OF STABILITY CONSTANTS OF PROTACTINIUM(V) AND NIOBIUM(V) OXALATO COMPLEXES BY A GRAPHICAL DIFFERENTIATION METHOD USING TRI-n-OCTYLAMINE FOR EXTRACTION. Maghrawi, H. B.; Abdel-Gawad, A. S.; Abdel-Rassoul, A. A. (Atomic Energy Establishment, Cairo). Indian J. Chem.; 9: No. 8, 867-9(Aug 1971).

Graphical differentiation was employed for determination of stability constants of oxalato complexes of protactinium(V) and niobium(V). The overall stability constants for protactinium complexes under the experimental conditions employed are: $\beta_1 = 5.0 \times 10^3$, $\beta_2 = 1.5 \times 10^7$, $\beta_3 = 1.5 \times 10^{10}$ and $\beta_4 = 1.7 \times 10^{13}$, and for niobium: $\beta_1 = 2.0 \times 10^3$, $\beta_2 = 2.4 \times 10^6$ and $\beta_3 = 9.4 \times 10^8$. The results show that protactinium oxalato complexes are more stable than the corresponding niobium species. (auth)

15014 NEW COMPOUND OF URANIUM OXALATE WITH HYDRAZINE. Bykhovskii, D. N.; Petrova, I. K. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 494-5(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 470-2(May-Jun 1971).

Aqueous solutions containing uranyl ions and oxalate ions and some hydrazine salt were poured together and the compounds formed were studied. Only mononuclear complexes existed in solution at the uranium concentrations studied. (M.C.G.)

15015 INVESTIGATION OF FACTORS DETERMINING THE SOLUBILITY OF AMINE SALTS AND COMPOUNDS EXTRACTED BY THEM IN ORGANIC DILUENTS. II. SOLUBILITY OF COMPOUNDS OF THORIUM NITRATE WITH AMINE NITRATE. Mezhov, E. A.; Sokolov, V. S.; Shesterikov, V. N.; Shmidt, V. S. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 475-8(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 456-9(May-Jun 1971).

With increasing length of the hydrocarbon chains of the amino, the volume of alcohol necessary to ensure complete mutual solubility was reduced. When the number of alkyl groups in the amine is lowered, the solubility of the compound of its nitrate with thorium nitrate in kerosene was reduced. The solubility of the thorium compound increased with increasing dielectric constant of the diluent. (M.C.G.)

15016 INVESTIGATION OF THE FACTORS DETERMINING THE SOLUBILITY OF AMINE SALTS AND THE COMPOUNDS EXTRACTED BY THEM IN ORGANIC DILUENTS. III. SOLUBILITY OF COMPOUNDS OF URANYL NITRATE WITH AMINE NITRATES. Sokolov, V. S.; Shmidt, V. S.; Mezhov, E. A.; Shesterikov, V. N. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 479-81(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 459-61(May-Jun 1971).

When the length of the alkyl chain in the amine was increased, the amount of alcohol necessary to prevent stratification of the organic phase was reduced. The transition from hydrogenated kerosene to a more polar diluent led to an increase in the solubility of compounds of uranyl nitrate with amine nitrates in them. (M.C.G.)

15017 DETERMINATION OF THE SOLIDUS LINES OF DIRECTED CRYSTALLIZATION. III. PECULIARITIES OF THE USE OF LABELED ATOMS. Kosyakov, V. I. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 454-6(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 440-2(May-Jun 1971).

It is shown that there are two methods of determining the distribution coefficient with the aid of labeled atoms. The method without division of the ingot is useful in the region of low concentrations of the impurity, for concentration of a mixture of substances with a small difference in volume, and in work with substances that decompose in air and are highly hygroscopic. The second method, with division of the ingot, is more accurate, but less convenient. It should be used in cases where the first method gives a large error. (M.C.G.)

15018 ADSORPTION OF Pu(IV) ON A PRECIPITATE OF $BaSO_4$. Grebenshchikova, V. I.; Davydov, Yu. P.; Pershin, A. S. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 457-9(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 442-3(May-Jun 1971).

Studies were made on the adsorption of tetravalent plutonium in the region of its hydrolysis on a suspension of $BaSO_4$, recrystallized until the establishment of a constant surface. The equilibrium distribution of Pu(IV) between a $BaSO_4$ precipitate and its saturated solution is established in 10 to 15 min, which indicates adsorption trapping of plutonium by the surface of $BaSO_4$. The plutonium is trapped secondarily, i.e., it is included in the outer shell of the electrical double layer. (M.C.G.)

15019 ROLE OF HYDROLYSIS IN THE OXIDATION OF Pu(IV) BY OZONE IN NITRIC ACID SOLUTIONS. Vyatkin,

V. E.; Davydov, Yu. P.; Shashukov, E. A. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 492-3(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 469-70(May-Jun 1971).

Solutions of Pu(IV) were prepared and one part oxidized directly with ozone, while the other portion was acidified with HNO_3 to 0.2N before oxidation. The shape of the oxidation curves was analogous for both parts. It is shown that the oxidation is probably determined, practically from the beginning, by the course of the hydrolysis process. (M.C.G.)

15020 NATURE OF URANIUM(IV) BOROHYDRIDE. Volkov, V. V.; Grankina, Z. A.; Myakishev, K. G. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 416-19(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 401-5(May-Jun 1971).

The complete ir spectrum of uranium borohydride was taken. According to the data of ir spectroscopy, the $U(BH_4)_4$ molecule can be assigned a "bridge" structure, which is characterized by the presence of an essentially covalent U–B bond with the participation of "bridge" hydrogen atoms. It was shown by a thermographic investigation that $U(BH_4)_4$ has no phase transformations in the temperature interval from −180 to 55°C. The interplane distances that can characterize the borohydride of tetravalent uranium were determined. (auth)

15021 STABILITY OF THE SiF_6^{2-} ION IN AQUEOUS SOLUTIONS IN THE PRESENCE OF IONS OF METALS OF VARIOUS VALENCE. Krylov, V. N.; Komarov, E. V.; Pushlenkov, M. F. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 445-9(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 430-4(May-Jun 1971).

The method of cation exchange was used to show that in solutions of $HClO_4$ (2 and 1 M), containing ions of the hexavalent actinides (U, Np, or Pu) and H_2SiF_6, the complexes MeO_2SiF_6 are formed. The constants of formation of these complexes were calculated. The breakdown of SiF_6^{2-} ions occurs in solutions containing metal ions, the constants of formation of fluoride complexes of which lie in the range $10^2 < \beta_1^* \leq 10^3$. (auth)

15022 RADIOCOLLOIDS IN SORPTION SYSTEMS. VI. THE AQUA–ACID MODEL OF AN AGGREGATION OF HETEROGENEOUS PARTICLES. Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 371-7(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 357-63(May-Jun 1971).

The linear algebraic formalism of the description of the simplest aqua-acid model of a radiocolloid is discussed. The uniqueness of the maximum of the $\bar{c}$ versus pH isotherm is demonstrated within the framework of this model. (auth)

15023 SOME SEMIEMPIRICAL SORPTION PRINCIPLES, REDUCIBLE TO THE LAW OF MASS ACTION. Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 384-9(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 370-5(May-Jun 1971).

The semiempirical formulas $S \sim pH$, $\log S \sim pH$, $S \sim [m]$, and $\log S \sim [m]$, used in sorption problems of radiochemistry, were reduced to the law of mass action by the method of integral quadratic interpolation. The dependence of the coefficients of linearization on the interpolation interval $\Delta = S_2 - S_1$ and its midpoint was determined. In a number of cases the distortion of the graphs of these functions may be associated only with a disturbance of the conditions of satisfactory approximation of the distribution coefficient (or its logarithm) to the degree of sorption (or its logarithm). In this case, the deviation from linearity is not justifiably explained by physicochemical changes occurring in the system (hydrolysis of the sorbate, inhomogeneity of the sorbent, etc.). (auth)

15024 DETERMINATION OF THE SOLIDUS LINES OF DIRECTED CRYSTALLIZATION. II. METHOD OF WORK. Kirgintsev, A. N.; Aloi, A. S.; Kosyakov, V. I. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 366-70(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 352-6(May-Jun 1971).

A method was developed for determining the distribution of a radioactive tracer along an ingot after directed crystallization without dressing the ampoule. The optimum conditions were found for reaching the region of equilibrium crystallization in horizontal directed crystallization: internal diameter of ampoules ≥9 mm, rate of rotation of ampoules 200 to 350 rpm. The formation of solid solutions of cesium nitrate with potassium nitrate was demonstrated. The equilibrium distribution coefficient from microconcentrations (5×10^{-3}%) up to the eutectic concentration (40%) does not depend on the concentration and is equal to 0.30. (auth)

15025 RADIOCOLLOIDS IN SORPTION SYSTEMS. VII. CONSEQUENCES OF OLATION DIMERIZATION. Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 378-83(May-Jun 1971).
Translated from Radiokhimiya; 13: No. 3, 364-9(May-Jun 1971).

The shift of the maximum of the sorption $\bar{c}$ versus pH isotherm into the alkaline region of the pH axis, caused by an increase in the concentration of the cationic microcomponent-sorbate, treated as an aqua-acid, is a noncontradictory consequence of olation. (auth)

15026 ELECTROMETRIC AND I.R. SPECTRA STUDIES OF Th(IV)-5-NITRO-SALICYLATE. Khadikar, P. V.; Sarwate, A. G. (Madhav Science Coll., Ujjain, India). Sci. Cult. (Calcutta); 37: No. 5, 256(May 1971).

Conductometric and potentiometric studies were made of the reaction between Th(IV) and 5-nitrosalicylic acid. The equation $Th^{4+} + C_7H_5O_5N + 4OH^- \rightarrow [C_7H_3O_5NTh(OH)_2] + 2H_2O$ was deduced. (M.C.G.)

15027 MAGNETIC ORTHO-PARA CONVERSION OF HYDROGEN ON THE SURFACE OF NONSTOICHIOMETRIC URANIUM OXIDES. Romanowski, Wladyslaw; Wozniakowski, Boguslaw (Inst. for Low Temperature and Structure Research, Wroclaw). Rocz. Chem.; 45: No. 9, 1549-57(1971).

Measurements of the ortho-para hydrogen conversion rate on nonstoichiometric uranium oxides within the composition range UO_2 to U_3O_8 were carried out at 77°K. The results were interpreted in terms of coverage with hydrogen, number of paramagnetic centers on the surface, and their magnetic moments. (auth)

15028 KINETIC AND PRODUCT STUDY OF THE REACTION OF PHENOL WITH CHLORINE OXIDANTS AND OF URANIUM(IV) WITH CHLORINE(III) IN THE PRESENCE OF PHENOL. Grimley III, Eugene Burhans. Iowa City, Iowa; Univ. of Iowa (1971). 187p. University Microfilms Order No. 71-22,030.
Thesis.

Research was initiated to determine the identity of the chlorine species scavenged by phenol in the reaction of uranium(IV) with chlorine(III) in the presence of phenol in acidic aqueous solution. For purposes of comparison, it was necessary to determine the kinetic behavior of the reactions between phenol and the chlorine oxidants that are capable of existence in solution. The solution conditions were the same as those for the reaction of uranium(IV) with chlorine(III) in the presence of phenol. Chlorine dioxide was found to react with phenol via parallel paths to give a multi-term rate law. There was a hydrogen ion dependent and a hydrogen ion independent term. A term was also found for the reaction of a $[Cl_2O_4]^-$ complex with phenol in the presence of large amounts of added chlorine(III). In 1 M and 0.01 M perchloric acid concentrations and 1 M ionic strength at 25°C, the observed second order rate constants were found to be 0.48 and 1.57 M^{-1} sec^{-1}. The kinetic evidence indicates that the first step of the reaction is a one electron transfer from chlorine dioxide to phenol. Consecutive reactions were observed in the reactions of aqueous chlorine with phenol. The first reaction corresponds to the formation of a $[Cl_2 \cdot \phi OH]$ complex with an observed second order rate constant equal to $(2.3 \pm 0.5) \times 10^4$ M^{-1} sec^{-1} at 5.0°C. The second reaction is a first order decomposition of the complex via three parallel paths: a hydrogen ion and chloride ion dependent path; a hydrogen ion dependent path; and a hydrogen ion and chloride ion independent path. The major phenolic products found for all the systems studied, including the uranium(IV)-chlorine(III) reaction in the presence of phenol, were chlorophenols. Comparison of kinetic results indicates that the intermediate species scavenged by phenol must be chlorine and $[Cl_2O_2]$. Chlorine accounts for at least 10% of the scavenged species in 1 M perchloric acid and would account for greater than 10% of the scavenged species with addition of chloride ion. Under the reaction conditions studied, it is not possible for chlorine to account for the entire scavenged species, therefore, $[Cl_2O_2]$ must be scavenged, also. (Diss. Abstr. Int., B)

15029 THORIUM COMPLEXES. Th(IV)-[[(3,4-DIHYDROXY-2-ANTHRAQUINONYL)-METHYL]IMINO]DIACETIC ACID (ALIZARINE COMPLEXON). Negoiu, D.; Marica, M.; Turcu, V. An. Univ. Bucuresti, Chim.; 18: No. 2, 153-9(1969). (In Rumanian).

A spectrophotometric study has been made of the system thorium–alizar in complexon. A unique colored compound forms, corresponding to the molar ratio Th : aliz. = ½. The conditions for maximum stability include a concentration $< 2 \times 10^{-4}$ M and fairly high acidity (pH = 3.5), and apply both to an aqueous system and a 35% propyl alcohol-water system. (tr-auth)

15030 CRYSTAL STRUCTURE OF $K_7Th_6F_{31}$. Brunton, George (Oak Ridge National Lab., Tenn.). Acta Crystallogr., Sect. B; 27: 2290-2(15 Nov 1971).

The complex fluoride $K_7Th_6F_{31}$ is isostructural with $Na_7Zr_6F_{31}$. It is trigonal, $R\bar{3}$, with hexagonal axes a_0 = 15.293 (2) and c_0 = 10.449 (2) Å, Z = 3 and ρ_{cal} = 5.307 g.cm^{-3}. The eight Th–F distances range from 2.24 (1) to 2.41 (1) Å. The K–F distances range from 2.63 (2) to 3.36 (2) Å. (auth) (Denmark)

15031 POLAROGRAPHY OF SEAWATER. II. COMPLEX FORMATION OF CADMIUM WITH EDTA. Maljkovic, Dubravka; Branica, Marko (Inst. Rudjer Boskovic, Zagreb. Univ., Zagreb). Limnol. Oceanogr.; 16: No. 5, 779-85(Sep 1971).

Complex formation of cadmium with ethylenediaminetetraacetic acid in seawater and in sodium chloride solution was studied by square-wave polarography. The rate of complex formation in seawater is lower than that of the same reaction in the corresponding solution of sodium chloride or calcium and sodium chlorides. The influence of chloride and calcium ions on complex formation in sodium chloride solutions was investigated and the results indicate that the degree of complex formation of cadmium with EDTA is diminished by the formation of cadmium monochloro complex and by the competition between calcium and cadmium. (auth)

15032 COMPLEXES OF 5,5'-THIODISALICYLIC ACID WITH SOME d^{10}-TRANSITION METAL IONS. Nigam, H. L.; Pandeya, K. B.; Srivastava, P. C. (Univ. of Allahabad, India). Curr. Sci. (India); 40: No. 22, 600-1(20 Nov 1971).

The isolation and characterization of complexes of Ag, Hg, Th, and UO_2 with 5.5'-thiodisalicylic acid are described. (M.C.G.)

15033 CRYSTAL STRUCTURE OF AMMONIUM HEPTAFLUOROTHORATE, AMMONIUM CATENA-di-μ-FLUOROPENTAFLUOROTHORATE(IV). Penneman, R. A.; Ryan, R. R.; Kressin, I. K. (Los Alamos Scientific Lab., N. Mex.). Acta Crystallogr., Sect. B; 27: 2279-83(15 Nov 1971).

Anhydrous $(NH_4)_3ThF_7$ is formed from $(NH_4)_3ThF_8$ upon equilibration with concentrated aqueous NH_4F solution (~36 wt. %). Its crystal structure was determined from counter measurements of 1053 reflections. Cell dimensions are a = 13.944 (4), b = 7.928 (2) and c = 7.041 (4) Å, space group Pnma, Z = 4, D_x = 3.57, D_m = 3.6 g.cm^{-3}. The structure was refined by full-matrix least-squares methods to an unweighted crystallographic R value of 0.042, with all atoms except hydrogen having anisotropic thermal parameters. The structure consists of chains parallel to the b axis in which thorium is nine-coordinated by fluorine atoms in a tricapped trigonal prism arrangement. Th–F distances span the range of 2.25 Å (unshared F) to 2.59 Å (shared F) with a mean value of 2.40 Å. The minimum F–F distance is 2.50 Å between bridging fluorine atoms; for unshared fluorine atoms the minimum F–F distance is 2.72 Å. Hydrogen positions were not found, but the N–F distances are normal for hydrogen bonding. (auth) (Denmark)

15034 STUDIES ON THE HYDROLYSIS OF METAL IONS. 61. HYDROLYSIS OF THE THORIUM(IV) ION IN LITHIUM, POTASSIUM, AND MAGNESIUM NITRATE MEDIA. Milic, Nikola B. (Royal Inst. of Tech., Stockholm. Boris Kidric Inst. of Nuclear Sciences, Belgrade). Acta Chem. Scand.; 25: No. 7, 2487-98 (1971).

The hydrolysis equilibria of Th^{4+} in the media 3 M (Li)NO_3, 3 M (K)NO_3, and 3 M (Mg)NO_3 was studied at 25°C by emf titrations using a glass electrode in a concentration range for Th between 0.100 and 0.001 M. A large number of combinations of hydrolysis products $Th_q(OH)_p$ were tried using the generalized least squares program LETAGROP. The "best" sets of complexes and their equilibrium constants (β_{pq}) are given. The main species (2,2) is the same in all three media, but some of the secondary species found are different. (auth) (Denmark)

15035 URANIUM IN OXIDATION–REDUCTION REACTIONS UNDER HYDROTHERMAL CONDITIONS. Rafal'skii, R. P. Dokl. Akad. Nauk SSSR; 199: No. 2, 448-51(11 Jul 1971). (In Russian).

Equilibrium concentrations of components were determined in oxidation–reduction conditions existing in the reaction of UO_2SO_4 with sulfur and water, and the corresponding equilibrium constants were calculated for the temperature range 150 to 360°C. From these data a graph was prepared in such a manner as to show fields of stability of certain minerals that could participate in such a system under hydrothermal conditions. (K.S.W.)

15036 CRYSTAL STRUCTURE OF A TETRANUCLEAR HYDROXO COMPLEX OF URANYL(VI). Aaberg, Maertha (Royal Inst. of Tech., Stockholm). Acta Chem. Scand.; 25: 368-9(1971).

An attempt to isolate polynuclear complexes from hydrolyzed aqueous solutions of uranyl (VI) chloride resulted in the formation of crystals containing a tetranuclear complex having the composition $[(UO_2)_4O_2(OH)_2Cl_2(H_2O)_8]XH_2O$, where X is probably equal to 4. The symmetry group is monoclinic and the space group is No. 14: $P2_1/n$. The unit cell contains two formula units and has the dimensions: a = 11.645 Å, b = 10.101 Å, c = 10.206 Å and β = 105.77°. The structure is shown and a full report will be published when further data have been collected and analyzed. (Denmark)

15037 ELEKTROMIGRATSIONNYI METOD V FIZIKO-KHIMICHESKIKH I RADIOKHIMICHESKIKH ISSLEDOVANIYAKH. (Electromigration Method in Physiochemical and Radiochemical Investigations). Shvedova, V. P. Moscow; Atomizdat (1971). 288p.

The electromigration method and its theoretical basis and uses are discussed. Techniques are given for determining ion mobility in solutions by moving boundaries, by the use of radioisotopes, and by zone electrophoresis. Electromigration procedures are recommended for elements in each of the groups of the periodic table. A final chapter is devoted to electromigration of ions in molten salts. (662 references) (K.S.W.)

15038 CONDUCTANCE IN CONCENTRATED TERNARY SYSTEMS. Kalman, Erika (Research Lab. for Chemical Structures, Budapest). Z. Phys. Chem. (Leipzig); 248: No. 1-2, 123-7(1971). (In German).

The specific conductivity of four uranyl salts in aqueous solution at 25°C was measured at a constant perchloric acid concentration of 0.1 M. The uranyl salts were $UO_2(ClO_4)_2$, $UO_2(NO_3)_2$, UO_2Cl_2, and UO_2SO_4, and their concentrations ranged from zero to 3 or 4 M. The conductivities of these four ternary systems exhibited maxima between 1 and 2 M, and were always less than the sum of the separately measured conductivities of 0.1 M perchloric acid and a given uranyl salt. Other examples of this "conductivity loss" are discussed. (K.S.W.)

15039 APPLICATION OF CORRELATION METHOD TO ANALYSIS OF GAMMA RAY SPECTRUM. Ueda, Katsuhiko (Nara Technical Coll., Japan); Ishiketa, Tadashi; Nishikawa, Kiyoshi. Radioisotopes (Tokyo); 20: No. 12, 649-54(Dec 1971). (In Japanese).

The cross correlation method was applied to the determination of an unknown energy spectrum of γ rays from observed data using a particular γ detector. This method is as follows: taking the response of the detector for monochromatic γ rays as the search spectrum, the cross correlation function between the search spectrum and the data spectrum is computed. The application of the cross correlation method to the observed results enables the energy spectrum of γ rays to be determined using an organic scintillator. The measurements are performed for γ rays of radioactive sources with energy over a range from about 0.5 to 1.8 MeV. As compared with both methods, the response matrix method and that using Fourier transformations, the special merit of this method is that the computing time is very short because the process of computation is simpler than those for the former two methods. For example, the time for processing data obtained by a 400-channel detector is less than 10 sec by using the FACOM computer model 230-60. The resolving power by this method, the FWHM value of the peak was in the range from ~25% to ~90% for the change of energy of γ rays, was poorer than that by using an inorganic scintillator such as NaI(Tl). However, this problem will be improved with determination of the shape of the search spectrum and of the process of the computation. (auth)

Radioactive Waste Treatment

Refer also to abstract 14703.

15040 CONTRIBUTION TO THE DECONTAMINATION OF CONTAMINATED POLYETHYLENE BY MEANS OF TENSIDE SOLUTIONS. Egginger, R. (Bundesanstalt fuer Fleischforschung, Kulmbach, Ger.). Tenside; No. 3, 134-6(1971). (In German).

The decontamination of contaminated polyethylene by means of surfactant solutions was investigated. Compared with tap water in the case of nuclides applied from weakly acid solution it was possible to reduce the initial activity by about 60% after three decontamination operations. With the nuclides deposited from neutralized solutions, for ^{144}Ce–^{144}Pr about 90% removal was obtained and for ^{95}Zr–^{95}Nb there was no significant difference compared with tap water; in the latter case the decontamination was about 70%. (INIS)

15041 METHOD OF DECONTAMINATING RADIOACTIVE METAL SURFACES. Jordan, William T.; Zimmerman, Cort A. (to United States Atomic Energy Commission). U. S. Patent 3,615,817. 26 Oct 1971. Filed 4 Feb 1969.

A method is described for decontaminating radioactive metal surfaces and particularly difficulty accessible radioactive surfaces such as the ceiling and walls of a reactor vessel. The decontamination is accomplished by carrying a decontaminating reagent to the surfaces in a foam. Consecutive applications of

alkaline permanganate and oxalic acid in foam give particularly good results. A nonionic foaming agent should be employed when the foaming agent may come into contact with a solution containing aluminum ions. (auth)

15042 STUDY OF THE ION EXCHANGE PROPERTIES OF ZEOLITES WITH RESPECT TO RADIOACTIVE RARE EARTH ELEMENTS. Brezhneva, N. E.; Dement'ev, V. D.; Kapshaninov, Yu. I.; Popov, I. B. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 426-31(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 411-16(May-Jun 1971).

The exchange of Na and Ca ions for ions of the rare earth elements on zeolites of the NaX and CaA type was investigated. The maximum exchange capacity of NaX zeolite for all the elements investigated is the same and equal to 0.360 meq per 100 mg of zeolite, and the degree of replacement of Na ions is 82%. The following selectivity series was obtained: $La^{3+} > Ce^{3+} > Pr^{3+} > Nd^{3+} > Pm^{3+} > Sm^{3+}$, up to an approximately 80% degree of exchange, and it was shown that at greater degrees of exchange there is an inversion of selectivity. The degree of exchange does not depend on the concentration of the initial solution of the rare earth element in the range from 0.01 to 1N solutions. The mobility of the rare earth ions in zeolite is lower than the mobility of Na ions. (auth)

Radioisotope Production

15043 (CONF-680423–, pp 183-94) RADIOCHEMICAL SEPARATION OF ^{99m}Tc AND ^{99}Mo. Archundia, C. (Comision Nacional de Energia Nuclear, Mexico City); Butement, F. D. S. (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

A method for the efficient separation of ^{99m}Tc and ^{99}Mo from MoO_3 irradiated in a reactor by means of a continuous extraction with 2-pentanone was developed. The distribution coefficients of Mo(VI) and ^{99m}Tc(VII) in various organic solvents were determined. The distribution coefficients of ^{99m}Tc(VII) and Mo(VI) in various concentrations of H_2SO_4 were also determined. The apparatus for the continuous extraction and the extraction procedure were described. The theory of the extraction was discussed. The determination of the purity of ^{99m}Tc showed that the method described gives the isotope in such high purity that it can be used for oral administration in the study of the function of the thyroid plant. (J.S.R.)

15044 (CONF-680423–, pp 207-24) SYNTHETIC ACTINIDES: FROM DISCOVERY TO MANUFACTURE. Seaborg, Glenn T. (Atomic Energy Commission, Washington, D. C.).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The actinides discussed with respect to discovery, production, and applications are neptunium, plutonium, americium, curium, berkelium, and californium. The discovery of einsteinium and fermium is considered briefly, and some novel criticality aspects of actinides and superheavy elements are discussed. (D.H.M.)

15045 (CONF-680423–, pp 299-302) PRODUCTION OF RADIOISOTOPES IN GENERATORS. Cendales R., M. A. (Instituto de Asuntos Nucleares, Bogota (Colombia)). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The use of long-lived radioisotopes from which short-lived daughter isotopes can be separated at intervals is one source of isotopes in countries with no reactor or strong irradiation source. Radioisotope pairs suitable for use in these generators are tabulated. Long-lived isotopes with useful daughters include ^{90}Sr for the production of ^{90}Y and ^{68}Ge for the production of ^{68}Ga. The mother isotopes with average half-life of the order of days which can produce useful daughters include ^{99}Mo for the production of ^{99m}Tc, ^{132}Te for ^{132}I, and ^{103}Ru for ^{103m}Rh. The production of radioisotopes in generators is an easy and economical process which would permit the amplification of the use of active nuclides in the Latin American countries. (J.S.R.)

15046 (INP–770) PRODUCTION OF CARRIER-FREE RADIOISOTOPES FROM TARGETS IRRADIATED WITH DEUTERONS OR ALPHA PARTICLES IN THE U-120 CRACOW CYCLOTRON. PART 3. PREPARATION OF RADIOISOTOPES OF TERBIUM, DYSPROSIUM, AND LUTETIUM FROM TARGETS OF EUROPIUM, GADOLINIUM, AND THULIUM. Kopta, S.; Petryna, T.; Stronski, I. (Institute of Nuclear Physics, Krakow (Poland)). Sep 1971. 12p. Dep. NTIS (U. S. Sales Only).

The results of experiments on the preparation of carrier-free lanthanides from some targets irradiated in the U-120 cyclotron are presented. In the ^{151}Eu(α,n)^{154m,154}Tb and ^{151}Eu(α,2n)^{153}Tb, ^{155}Gd(α,2n)^{157}Dy, and ^{169}Tm(α,n)^{172}Lu and ^{169}Tm(α,2n)^{171}Lu reactions the isotopes of $^{154m,154+153}$Tb, ^{157}Dy, and $^{172+171}$Lu were obtained. They were prepared by means of the ion-exchange chromatography method. (auth)

15047 SEPARATION OF MILLIGRAM QUANTITIES OF ^{252}Cf FROM MULTIGRAM QUANTITIES OF ^{244}Cm AND ^{243}Am. Burney, G. A.; Harbour, R. M. (Savannah River Lab., Aiken, S. C.). Contract (07-2)-1. Radiochim. Acta; 16: No. 2, 63-6(Nov 1971).

A process was developed to separate milligram quantities of ^{252}Cf from multigram quantities of ^{244}Cm and ^{243}Am with the technique of pressurized cation exchange elution chromatography. Ammonium α-hydroxyisobutyrate was used as the elutriant in a pH-gradient elution. An in-line radiation monitoring system gave exact elution profiles for ^{252}Cf, ^{244}Cm, ^{243}Am, ^{154}Eu, ^{144}Ce, ^{254}Fm, ^{253}Es, and ^{250}Bk. (auth)

15048 PRODUCTION OF ^{99m}Tc USING BIS(2-ETHYL HEXYL) PHOSPHORIC ACID. Alian, A.; Born, H.-J.; Staerk, H. (Technische Univ., Munich). Radiochim. Acta; 16: No. 2, 75-8(Nov 1971).

A rapid method for the production of ^{99m}Tc from irradiated molybdenum is described. The procedure is based on extraction of molybdenum by bis(2-ethylhexyl) phosphate (DEHPA) from 2N HNO_3. Accumulated ^{99m}Tc can then be eluted from the loaded solvent into dilute hydrochloric, hydrobromic, perchloric, nitric, or sulfuric acid solutions, as well as into an isotonic saline solution. Data on the extraction of molybdenum and technetium from these media were obtained as a preliminary step in the present study. The produced technetium was found to be free from molybdenum as well as from any other foreign activity. (auth)

15049 SEPARATION OF CARRIER-FREE ^{111}Ag FROM NEUTRON IRRADIATED PALLADIUM. Abdel-Rassoul, A. A. Radiochim. Acta; 16: No. 2, 116(Nov 1971).

Separation of carrier-free ^{111}Ag from neutron-irradiated palladium was achieved by cocrystallization with NaCl. In the presence of palladium the cocrystallization coefficient was 5.0 and the formation of anomalous mixed crystals with $PdCl_2$ did not occur. A 95% yield and a radiochemical purity exceeding 99.9% were achieved. (M.C.G.)

15050 PURIFICATION OF ^{99}Mo FROM RADIOCONTAMINANTS IN PILE-IRRADIATED MOLYBDENUM. El-Garhy, M.; El-Bayoumy, S.; Abdullah, E. (Atomic Energy Establishment, Cairo). Strahlentherapie; 142: No. 3, 376-9(Sep 1971).

An efficient method was established for the purification of ^{99}Mo from radiocontaminants that might be produced on pile irradiation of molybdenum. The process depends on the preferential adsorption and subsequent desorption of the components from alumina at different medium acidities. The purified ^{99}Mo product may be used for further production of ^{99m}Tc for medical purposes. (auth)

15051 POSSIBILITY OF SEPARATING TECHNETIUM FROM MOLYBDENUM AND RHENIUM FROM TUNGSTEN BY THE METHOD OF EXTRACTION WITH 8-MERCAPTOQUINOLINE. Avad, Kh. K.; Kuznetsov, V. I.; Rudenko, N. P.; Gudym, L. S. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 472-4(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 453-6(May-Jun 1971).

The possibility of extraction separation of the daughter technetium-99m from neutron-irradiated molybdenum and that of rhenium from neutron-irradiated tungsten with the aid of 8-mercaptoquinoline was investigated. (auth)

15052 PURITY OF ELUATES FROM ^{99m}Tc GENERATORS. Mueller, Th.; Steinnes, E. (National Health Service of Denmark, Copenhagen. Institutt for Atomenergi, Kjeller, Norway). Scand. J. Clin. Lab. Invest., 28: No. 2, 213-17(Oct 1971).

Five different ^{99}Mo/^{99m}Tc generators of the Al_2O_3 type were studied. Results for recovery of $^{99m}TcO_4^-$, radionuclidic purity, radiochemical purity, and aluminum content of the eluates are presented. A rapid thin-layer chromatographic method for the determination of radiochemical purity is introduced. Atomic absorption spectroscopy and neutron activation analysis were used to determine soluble and particulate aluminum, respectively. The eluates generally showed high and satisfactory radionuclidic and radiochemical purity. Aluminum was found at highly variable concentrations and was found to be present essentially in soluble form. (auth) (Norway)

15053 USE OF A FIBROUS SULFONATE SORBENT FOR THE ISOLATION OF RADIOACTIVE IODINE. Brevnova, N. V.; Bekisheva, E. V.; Kirilenko, Yu. K.; Vol'f, L. A.; Meos, A. I. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 462-4(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 445-7(May-Jun 1971).

Isotopic exchange methods were proposed for the selective isolation of radioactive iodine from fission products and a concentration of various radioactive cations, using a sulfonate fibrous ion exchange resin. (auth)

15054 MANUFACTURE OF ^{133}I FOR DIAGNOSTIC PURPOSES. Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf, Austria). Kerntech. Atomprax.; 13: No. 10, 447-9(Oct 1971). (In German and English).

The formation of ^{133}I and its contribution to the total fission iodine activity is discussed, with calculations and graphs. The best time for administration to the patient seems to be between 30 and 40 hours after the end of irradiation; this was confirmed by gamma spectra recorded at various times after the isolation of the fission iodine fraction. It proved possible to measure ^{133}I in the presence of ^{131}I. The yield from 10 mg U_3O_8 enriched to 93% ^{235}U was 110 mCi ^{133}I. (auth)

15055 SEPARATION OF ^{132}I FROM ^{132}Te. Sokolov, V. A.; Levin, V. I.; Kondrat'eva, T. I. (to Inst. of Biophysics). Russian Patent 220,237. 25 Apr 1969. Filed 9 Mar 1967. (In Russian).

As part of the process of separation of ^{132}I from ^{132}Te located on a resin sorbent, it is proposed to use a mixture of solutions of ascorbic acid and $NaHCO_3$ as an eluant. The solution of ^{132}I thus obtained contains about 99% of the I in the form of iodide and has a pH of 7 to 8. (K.S.W.)

15056 EXTRACTION OF TRIVALENT METALS BY ALKYLAMMONIUM SALTS. Mueller, W. (EURATOM, Karlsruhe, Ger.). Chem. Ztg.; 95: No. 11, 499-507(1971). (In German).

Trivalent metals (iron, lanthanides, actinides) can be extracted from aqueous phases by long-chain amine salts. In organic solutions, the alkylammonium salts form ion pairs that associate with decreasing polarity of the diluent. The decreasing solvation enhances the extraction of the anionic metal complexes. Complexes containing two molecules of alkylammonium salts per metal atom are observed in the organic phase either when lanthanides and actinides are extracted from concentrated chloride solution or when iron is extracted from dilute HCl. This 2:1 complex is assumed to result from the association of the 1:1 complex and a molecule of alkylammonium salt, thus forming an ion quadrupole. The extraction by alkylammonium salts can be applied for the determination of small amine concentrations or for the removal of iron from scrap alloys. Group separation of the lanthanides and actinides from concentrated LiCl solutions and the separation of the actinides into a Cf and Am–Cm fraction are the basis of the TRAMEX procedure for the isolation of transplutonium elements on an industrial scale. Am and Cm can be separated by extraction chromatography from $LiNO_3$ solutions. (INIS)

15057 APPARATUS FOR THE DISTILLATION OF POLONIUM FROM BISMUTH. Michels, Lloyd Richard (to United States Atomic Energy Commission). U. S. Patent 3,618,923. 9 Nov 1971. Filed 25 Aug 1969.

Polonium is distilled from bismuth under vacuum in a pot provided with a cover carrying a condenser that is positioned inside the pot. The condenser is filled with a liquid metal heat transfer medium in which heating elements and cooling elements are immersed. During distillation, the condenser is cooled and polonium freezes on it. The vacuum is then broken and the cover, with the attached condenser, is removed and carried to a receptacle, which may be another still pot. The condenser is then heated, melting the polonium. The polonium may be redistilled any desired number of times and further purified by chemical separation and/or solvent extraction. The apparatus may be used for the distillation of other metals. (auth)

15058 ^{99m}Tc GENERATOR BY USE OF SILICA GEL AS ADSORBENT. Maki, Yasuyuki (Industrial Research Inst. of Kanagawa Prefecture, Kanazawa, Japan); Murakami, Yukio. Nippon Kagaku Zasshi; 92: No. 12, 1211-12(Dec 1971). (In Japanese).

A ^{99m}Tc generator using silica gel as adsorbent and acetone as eluent was devised. One gram of MoO_3 irradiated with a thermal neutron flux of $5 \times 10^{11} n/cm^2$ sec for 6 hours was dissolved in 50 ml of 0.1 mole/l ammonia. A 10-ml portion of the solution was diluted with 50 ml of water, and 30 g of silica gel was added to it. After the mixture was dried at 110°C for 3 hours, it was packed in a column for milking. The ^{99m}Tc was eluted from the column by acetone. The radiochemical purity of ^{99m}Tc in the eluent was determined to be higher than 99.99% by analyzing the decay curve. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 14712 and 17230.

15059 (BNWL-CC-2461) PILOT PLANT DEMONSTRATION OF THE PLUTONIUM RECLAMATION FACILITY CC, CR, AND CX COLUMNS. Bonner, W. F.; Richardson, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb 1970. 30p. Dep. NTIS.

Pilot plant uranium losses in the CAIS (plutonium product stream from the CC (plutonium stripping) column) were below 0.04 g/liter, the maximum allowable contamination level, at near optimum pulsing conditions with up to 8 g/liter uranium in the CAP (CC column solvent feed stream). The maximum allowable uranium concentration in the PRF CAP was estimated to be only 5.4 g/liter, however, because of the inefficient removal of uranium from the solvent in the succeeding unpulsed CR and CX uranium stripping columns. A higher uranium concentration in the CAP would result in recontamination of the plutonium product by uranium recycle in the washed solvent used for the CCS (uranium scrub solution). Gassing from the nitrite–hydroxylamine reaction, as well as from air addition to the column, had little effect on column performance. Addition of 3/4-in. Kynar® rings between the scrub section sieve plates, to simulate the current plant cartridge, slightly improved scrubbing efficiency. Decreasing the HNO_3 in the organic scrub stream from 0.5 to 0.1M increased the uranium in the plutonium product stream from 0.004 to 0.08 g/liter. The CR and CX columns, operating unpulsed with aqueous phase continuous and an aqueous/organic (A/O) flow ratio of 0.33, were capable of stripping 10–20% and 92–96%, respectively, of the column feed uranium. The uranium concentration in the stripped organic, however, was 2 to 4 times the desired specification limit. Operation with the organic phase continuous or with an A/O ratio of 0.67 had only a small effect on uranium removal. Supplying a 2.25-in., 40 cycle/min pulse to the CR column improved the uranium and acid removal 30 to 50%, while addition of a pulse to the CX column decreased the uranium loss at least threefold. Pulsed operation of the CX column produced stripped organic solvent which was well within specifications. (auth)

15060 (CEA-R-4203) INDUSTRIAL DEVELOPMENTS BETWEEN 1967 AND 1970 AT THE LA HAGUE UP 2 PLANT. Delange, Maurice; Chambon, Marcel; Patigny, Pierre; Texier, Paul (Commissariat a l'Energie Atomique, La Hague (France)). 1971. 26p. (In French). Dep. NTIS (U. S. Sales Only).

Since its start-up after a series of active runs commissioned by its constructors, diverse work has been carried out at the La Hague Center. Research and development has considerably expanded the knowledge acquired by France in the reprocessing of irradiated fuel field since the Marcoule UP 1 plant went into operation in 1958. Interesting developments concern: the behavior and performance of trilaurylamine; the stability of phosphomolybdenum complexes; the ability of carrying out systematic chemical decanning of MGR fuels while, at the same time, releasing magnesium into liquid effluents; the technical and economic advantage of U(IV) processing by catalytic reduction with hydrogen under pressure; and the advantages of automatic analysis methods. Tests carried out at La Hague enabled the operating costs to be reduced and the capacity to be up-rated from 2 to 4 metric tons/day, while at the same time improving environmental safety. The plant is envisaged for multipurpose reprocessing on a European scale in 1975-1976. (auth)

15061 (DOCKET-50201-104) WEST VALLEY REPROCESSING PLANT. Low Level Liquid Waste Treatment Facility, Summary Report No. 2. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 14 Jan 1972. 27p. Dep. NTIS.

Operation of the Low-Level Liquid Waste Treatment Facility is summarized, and methods being developed to reduce strontium and cesium radioactivity in the liquid effluents are discussed. In order to avoid the degradation of the phenolic resins by nitric acid, a sulfuric acid elution system was installed. (M.C.G.)

15062 (DOCKET-50201-106) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Information Required in Support of Requested Change. (Division of Materials and Licensing (AEC), Washington, D. C.). 31 Jan 1972. 3p. Dep. NTIS.

Additional information is requested in support of the proposal to delete the ion exchange plutonium purification step by substitution of a second extraction cycle. (M.C.G.)

15063 (DOCKET-50268-23) MIDWEST FUEL RECOVERY PLANT. Final Safety Analysis Report, Amendment No. 22. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 12 Jan 1972. 43p. (NEDO-10178-10). Dep. NTIS.

Additional information is submitted in support of the final safety analysis report for the Midwest Fuel Recovery Plant. Topics discussed include: dry chemical vault corrosion and results of leakage, prevention of process steam from achieving 130°C, location of manual controls for fog-spray nozzles, criti-

cality safety analysis, construction analysis of cask-unloading basin, earthquake protection of essential instruments, and site flooding analysis. (M.C.G.)

15064 (DOCKET-50332-24) BARNWELL NUCLEAR FUEL PLANT. Settlement Report of Critical Structures. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 1 Feb 1972. 9p. Dep. NTIS.

Data are presented on settlement magnitudes, time rates, and differentials pertaining to critical structures for the Barnwell plant. Tabulated settlement predictions are based on the use of flexible base slabs. (M.C.G.)

15065 (ICP-1002) $H_2-O_2-NO_x$ FLAMMABILITY AND EXPLOSIBILITY: A LITERATURE SURVEY. Johnson, J. E. Jr. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs-Operations Office). Oct 1971. Contract AT(10-1)-1375. 27p. Dep. NTIS.

Results of a literature survey are presented concerning hydrogen flammability and explosibility. Combustion and explosion limits are given and effects of nitrogen oxides and other substances on these limits are discussed. Reaction mechanisms are included to help explain these effects. It was concluded that although nitrogen oxides do sensitize near-stoichiometric H_2-O_2 mixtures toward thermal ignition, they do not increase the flammability of hydrogen near its composition limits for combustion. These studies were made to evaluate hazards in fuel dissolution processes at ICPP. (auth)

15066 (KFK-1396) ON-LINE DATA ACQUISITION AND DATA REDUCTION FOR A COUPLED GAS CHROMATOGRAPH AND MASS SPECTROMETER WITH CALAS. Mache, R.; Rietzschel, K.; Gagel, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Datenverabeitung in der Technik). Jul 1971. 37p. (In German). Dep. NTIS (U. S. Sales Only).

An on-line data-acquisition and data-reduction system for a gas chromatograph-mass spectrometer combination is described using the process computer TR86 and the real-time system CALAS. The gas chromatograph-mass spectrometric system is used to identify radiolysis products in extraction systems such as TBP-hydrocarbons-nitric acid in fuel reprocessing. (M.C.G.)

15067 (SZS-12/71 (pp 11-22)) RADIATION PROTECTION AND NUCLEAR SAFETY IN REPROCESSING AND REFABRICATION PLANTS. Gegusch, M.; Kunze, B. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jul 1971.

A brief description is given of the procedures applied in reprocessing and refabrication of fuel elements for pressurized-water reactors and sodium-cooled fast breeder reactors. The problems of nuclear and radiation safety connected with these procedures are outlined, and principles for radiation protection and nuclear safety in reprocessing and refabrication plants are derived. (auth)

15068 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF REACTIONS OF EXTRACTION OF URANYL NITRATES BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. I. TRI-n-BUTYL PHOSPHATE (TBP). Komarov, E. V.; Shpunt, L. B.; Pushlenkov, M. F. Sov. Radiochem. (Engl. Transl.); 13: No. 3, 395-9(May-Jun 1971).

Translated from Radiokhimiya; 13: No. 3, 380-5(May-Jun 1971).

The structure of the solvate $UO_2(NO_3)_2 \cdot 2TBP$ was determined. The thermodynamic equilibrium constants of the extraction of uranyl nitrate by solutions of tributyl phosphate in carbon tetrachloride and n-decane were determined at 10 to 15°C. The thermodynamic functions of the extraction, ΔH, ΔG, and ΔS at t = 25°C were found. (auth)

15069 TRENDS IN THE REPROCESSING OF SPENT FUELS. Mamelle, J. (Saint-Gobain Techniques Nouvelles, Courbevoie, France). Kerntech. Atomprax.; 13: No. 11, 484-7(Nov 1971).

Reprocessing of spent fuels will require the building of large plants within the next decade. The Purex process is well adapted to highly irradiated fuels, provided a new type of equipment be designed for processing large flowrates of fissile materials. Developments of this equipment made in the past three years in France are reviewed, more particularly: chop and leach, extraction, plutonium tail-end, and waste management. (auth)

15070 ORGANIC PHASE REDUCTION OF PLUTONIUM IN A PUREX-TYPE PROCESS. Wilson, Archie S. (to United States Atomic Energy Commission). U. S. Patent 3,620,687. 16 Nov 1971. Filed 23 Apr 1969.

An improved method is described for the reduction of uranium (VI) to uranium(IV) in a solvent presence process for reprocessing irradiated nuclear reactor fuels using tributyl phosphate (Purex Process). Uranyl nitrate in a tributyl phosphite-hydrocarbon solvent-acid medium is subjected to ultraviolet light in the presence of a small amount of phosphoric acid. This in turn reduces plutonium(IV) to plutonium(III), which can then be separated from uranium. (auth)

15071 TENDENCIES IN DEVELOPMENT OF AQUEOUS REPROCESSING OF IRRADIATED NUCLEAR FUELS. Koch, G. (Kernforschungszentrum, Karlsruhe, Ger.). Chem. Ztg.; 95: No. 6, 275-92(1971). (In German).

The chemical processing of irradiated nuclear fuels is at present performed by counter-current solvent extraction with tributyl phosphate as the extractant. The basic aspects of this process are described. Development work is aimed at the accommodation of this successful technique to fuels from future advanced power reactors. Work is concentrated on the development of head-end processes, on the improvement and simplification of the extraction and separation of fuel and breeder materials, on controlling the radiolysis effects, and on the development of plant equipment. Increased interest in the isolation of by-products, in particular of the transuranium elements neptunium, americium, and curium, is noted. (INIS)

ENGINEERING

Energy Conversion

Refer also to abstracts 15125, 15619, 15654, 15736, 15739–15741, 15816, 15817, 15819, 15828, 16117–16120, 16175, 16631, 16632, and 17084.

15072 (AD–731290) BIBLIOGRAPHY OF ADVANCED PROPULSION AND RELATED CONCEPTS. Technical Report, January 1970–January 1971. Mead, Franklin B. Jr. (Air Force Rocket Propulsion Lab., Edwards AFB, Calif.). Jul 1971. 26p. (AFRPL-TR–71-99). NTIS.

The bibliography represents a compilation of technical documents surveyed during the calendar year of 1970. The documents cover various advanced propulsion concepts. (auth)

15073 (GEMS–2048-1(Vol.2)(Pt.1)) 250-WATT RADIOISOTOPE THERMOELECTRIC POWER SYSTEM. VOLUME II. PART 1. POWER SUPPLY TECHNICAL DESCRIPTION. Final Report, June 30–December 31, 1966. Gross, M. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Contract AT(29-2)-2048. 523p. (66-SD-2000-1-A). Dep. NTIS.

The final report on the development of a 250-W controlled intact reentry radioisotope thermoelectric power system for use on earth orbital missions is presented. The objectives of the program were to develop a reference design of a radioisotope-fueled thermoelectric power system which: uses a ^{90}Sr source but is capable of operating with a ^{238}Pu source; assures controlled intact reentry of the heat source within a preselected target area; and consists of an integrated package incorporating self-contained command, retrograde rocket, nuclear power subsystems, and other subsystems as required. The use of ^{238}Pu as an alternative heat source for extended duration missions was investigated. Detailed information is supplied on the radioisotope-thermoelectric generator and controlled intact reentry package, the design and performance requirements, conceptual design, safety analysis, power system alternatives, subsystems technologies, configuration selection, and the systems specifications evolved. (L.C.L.)

15074 (ORNL-TM–3592) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1971. Fraas, A. P.; Samuels, G. (Oak Ridge National Lab., Tenn.). Nov 1971. Contract W-7405-eng-26. 39p. Dep. NTIS.

The organic capsule test continued during the quarter and completed 6576 h or operation. Construction of the $\frac{1}{4}$-scale organic fluid decomposition test loop is proceeding. Most of the components have been fabricated and the measurements of the dose rates in the boiler region of the heat block shield were completed. Efforts to correct conditions that might cause a loss in the capillary pumping capacity of the heat pipe have continued to meet with little success; a pronounced loss in performance still occurs when the boiler is tilted a bit above the level of the condenser. Further investigation was discontinued due to lack of funds. Performance tests on the thermoelectric module were completed and the unit was delivered to ORNL for further testing. Two performance maps were completed for hot junction temperatures of 1000 and 1055°F (at 8 amps). The 1000°F hot junction map shows the unit output to be about 170 watts rather than the predicted value of 200 watts. Further tests of the aluminum wire screen thermal insulation-thermal fuse indicate that the combined effects of a low rate of temperature rise inherent in the application at hand, the very substantial heat of fusion of aluminum, and the inhibiting effects to the flow of molten aluminum imposed by a thick aluminum oxide film lead to a much less sharp melting of the thermal fuse than had been anticipated. To reduce thermal radiation losses, the next test sample has aluminum foil in the aluminum screen. A nitrogen atmosphere was employed to minimize the effects of the oxide film. At 15 psia and a mean temperature of 600°F the thermal conductivity was found to be 0.077 compared to 0.114 Btu/hr-ft-°F found during tests without the foil. A significant reduction in the thermal conductivity was also observed at 1.0 psia. However, during the course of this test the value of the conductivity shifted upward to form a higher curve. These tests will be repeated. A conceptual design for the dummy heat pipes for the test of the heat block with a thermoelectric module and 11 dummy modules has been prepared. A topical report reviewing the status of the development of various small turbine- and engine-generator units suitable for Navy undersea nuclear power plants was prepared. This indicates that the most promising candidate for an organic Rankine cycle system is the Sundstrand 6 kW(e) turbine-generator unit. The design of a full-scale organic Rankine cycle system employing the Sundstrand kW(e) turbine-generator unit is proceeding. A layout drawing was obtained from Sundstrand showing the revised arrangement of the 13 pipes and electrical cables which must be coupled to the turbine-generator-pump unit. The installation design problems associated with these connections were reviewed with Sundstrand and a satisfactory layout evolved. Arrangements for the procurement of the turbine-generator-feed pump unit have been initiated. (auth)

15075 (RCA–3484-92) HIGH TEMPERATURE CASCADED THERMOELECTRIC MODULE DEVELOPMENT PROGRAM AND MODULE TESTING. Final Report, December 1, 1964–February 28, 1966. (Radio Corp. of America, Harrison, N. J. Direct Energy Conversion Dept.). Contract AT(30-1)-3484. 132p. Dep. NTIS.

Cascade modules utilizing silicon-germanium thermoelectric materials in series with lead–telluride thermoelements were designed and tested. The basic design consisted of an Air-Vac SiGe cascaded with a pressure loaded PbTe element in a metallurgically bonded hermetic package. A conservative hot junction temperature of 842°F for the PbTe stage was selected for long term performance and reliability considerations. Combining the high temperature performance of SiGe couples with low temperature PbTe thermoelements led to substantial improvements in power output and efficiency for the cascade module as compared to a single stage PbTe generator operating under identical temperature conditions as the second stage of the cascade module. However, the power-to-weight ratio was not improved with respect to an all-SiGe module because of the added weight of the second stage. The electrical behavior of the SiGe stage was typical of Air-Vac state-of-the-art, demonstrated by the SNAP-17A data, when evaluated as an individual component. In cascade units, the SiGe stage shows sensitivity to thermal cycling due to the additional stresses introduced by the pressure loaded PbTe stage. Silicon-germanium 6-couple modules were tested at hot junction temperatures, T_h, of from 1500 to 1922°F and reject temperatures, T_c, of 900 to 1112°F. The power output for the SiGe stages ranged from 2.3 W at the lower ΔT to 6.3 W at the higher range. The power-to-weight ratio was 3.8 W/lb at the lower ΔT and 10 W/lb at the higher ΔT. Cascade modules having 6 SiGe and 12 PbTe couples, with a power-to-weight ratio of 2.7 W/lb, were tested in air at 1500°F for 3,200 to 4,000 hours. High-temperature oxidation of tungsten cold shoes operating at 932°F caused a decrease in power in the SiGe stage after 1900 hours of testing in air. The PbTe stage showed a modest degradation due to thermal cycling and good stability on life testing. A cascade module with 4 SiGe couples and 12 PbTe couples was evaluated on simulated missile vibration tests under operating conditions. The design did not pass the combined sine and random vibration tests at 23 g rms while operating with a hot junction temperature 1742°F. The failure of the PbTe stage on this test was believed due principally to the shortcomings of the hermetic package and isotherm plate and not to the PbTe elements. A redesign of the hermetic package and the isotherm plate is required before the device will meet the mechanical design goals. Life testing of silicon-germanium Air-Vac SNAP-17A modules in vacuum and air was continued throughout the 15 months covered by this report. Performance data beyond 15,000 hours is also discussed. (auth)

15076 (Y–1797) TIME FLUCTUATIONS OF TEMPERATURE IN A MAGNETOHYDRODYNAMIC PLASMA. Murray, E. M. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 24 Jan 1972. Contract W-7405-eng-26. 83p. Dep. NTIS.

An experimental investigation of the temperature of a potassium-seeded magnetohydrodynamic plasma was performed. The main means of obtaining temperature measurements incorporated an apparatus which contains two photomultiplier tubes that sensed light intensity fluctuations from the plasma. The plasma temperature, Hall voltage, and static pressure parameters of a Hall generator were analyzed for functional dependence of one parameter on another. Two separate temperature measurement techniques were utilized in this experimental investigation: (1) measuring the electrical conductivity of the plasma from the Hall channel from which a temperature measurement was obtained and (2) incorporating the ratio of the outputs of both the photomultiplier tubes and a mathematical derivation from Planck's blackbody radiation law to obtain a temperature determination. Voltage signals from equipment sensing the plasma parameters were recorded and the auto-correlation and cross correlation functions were determined. (auth)

15077 HEAT RELEASE NON-UNIFORMITY EFFECT ON THERMIONIC CONVERTER ELECTRICAL CHARACTERISTICS.

Ushakov, B. A.; Nikitin, V. D.; Korbut, V. Yu. At. Energ. (USSR); 31: No. 5, 467-72(Nov 1971). (In Russian).

A hypothetical thermionic converter with tungsten emitter has been used to analyze theoretically the effect of nonuniformity of heat release on the average specific electrical output of converter under arc modes of operation. The voltage–current characteristics of a converter with isothermal emitter, obtained experimentally were used in the analysis. The effect of non-uniformity of heat release on the converter emitter temperature was also considered and the corresponding temperature distribution is given. The dependence of the converter electrical output on nonuniform heat release coefficient was obtained for the emitter operating temperature range from 1700 to 2000°K. (auth)

15078 CONCEPTUAL DESIGN OF A 150-kWe OUT-OF-CORE NUCLEAR THERMIONIC CONVERTER SYSTEM. Ward, James J.; Breitwieser, Roland; Williams, Richard M. (Lewis Research Center, Cleveland). pp 179-84 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Nuclear-thermionic systems with the thermionic converters outside the reactor have been re-examined in the perspective of several recent technical advances: new high-temperature, corrosion-resistant, high-strength alloys; high-heat-flux heat pipes; improved thermionic converters; and light-weight, vapor-cooled radiators. These have been combined to yield a new look to the out-of-core approach. A versatile, compact reactor results; insulators are eliminated by the use of heat pipes as electrically resistive elements; and weights are reduced by combining vapor-cooled radiators, structural supports, and current leads into vapor-cooled radiator modules. The over-all design is also highly modular and thus provides high reliability and a reduction in development time and costs. (auth)

15079 USE OF HEAT PIPES FOR ELECTRICAL ISOLATION. Breitwieser, Roland (Lewis Research Center, Cleveland). pp 185-90 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Some of the problems of electrical isolation of the emitter from the heat source in out-of-core thermionics can be circumvented by the use of long heat pipes as electrical resistive elements. The various relations governing electrical resistance, heat pipe geometry, heat pipe pumping limits, and temperature losses were used to estimate the performance of heat pipes used in this manner. The design variables are the form of the electrical network, heat pipe length, heat pipe diameter, wall thickness, the wick design in the adiabatic section of the pipe, and heat pipe materials. First order calculations project the attainment of 28 volts with small penalties in system performance. (auth)

15080 DESIGN OPTIMIZATION OF AN OUT-OF-CORE THERMIONIC CONVERTER. Williams, Richard M. (Lewis Research Center, Cleveland). pp 191-5 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The design optimization of an out-of-core thermionic converter module is described. The module is a cylindrical converter, heated and cooled by heat pipes, with an integral finned radiator. Performance data illustrating the dependence of electrode efficiency and power density on emitter and collector temperature are used as input data. Design parameters such as electrode thickness and area, and current-voltage operating points are varied and the minimum specific weight design is determined. For fixed converter designs the sensitivity of performance to changes in heat pipe vapor temperature, electrical load, and radiator area is also explored. (auth)

15081 IN-PILE TESTS OF MULTIELEMENT THERMIONIC CONVERTERS WITH MOLYBDENUM- AND TUNGSTEN-BASED CATHODES. Kuznetsov, V. A. (Inst. of Physics and Power Engineering, Moscow). pp 196-202 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The results of the in-pile tests of five-element thermionic converter assemblies carried out in the power reactor of the first atomic power station as well as the results of the tests of six-element assemblies performed in the research reactor WWR-M are reported. The in-pile tests of multielement converters represent a continuation of the research program started with one- and three-element assemblies. Primary emphasis in these studies was placed on the converters whose emitters are made of molybdenum- and tungsten-based alloys. The in-pile tests are also carried out with the converters having the cathode cans of monocrystal molybdenum with specially oriented faces. Primary attention was given to the results of five-element assembly tests with the molybdenum-based cathode cans. (auth)

15082 THEORY OF THERMIONIC CONVERTER SURFACE PHENOMENA. McCandless, R. J.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif.). Contracts No. N00014-69-C-0247; AT(04-3)-771. pp 210-16 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The requirements placed on surface physics theories for the purpose of thermionic converter analysis were reviewed. The ability of available surface physics theories to meet these requirements is examined. It was found that existing surface physics theories are inadequate for meeting the needs of thermionic converter analysis. To meet present needs, a theoretical approach is developed for describing thermionic converter surface phenomena in terms of available or measurable crystallographic and atomic properties. The theoretical formalism recognizes that adsorbed particles may exist on a surface in a large number of different energy states. Approaches for relating work functions, desorption energies and desorption rates to atomic and crystallographic properties are discussed. The formalism provides a means for defining electrode characterization parameters that uniquely define the thermionic properties of electrodes. The approach is shown to offer a number of advantages over existing descriptions of thermionic converter surface phenomena and is shown to provide a consistent basis for the interpretation and comparison of existing theories. (auth)

15083 APPROXIMATE ANALYTIC TECHNIQUE FOR DETERMINING THE OPERATING CHARACTERISTICS OF THERMIONIC CONVERTERS IN THE IGNITED MODE. Keck, James (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-4125. pp 217-26 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

An approximate analytic technique for solving the transport equations describing the diffusion region of a thermionic energy converter operating in the ignited mode has been developed. The method involves assuming a parametric form for the electron production and integrating the transport equations to determine the electron concentration, potential, and temperature distribution. These distributions are then used to determine the electron production from the ionization equation. Finally the parameters are adjusted to make the assumed production match the calculated production as closely as possible. In the initial investigations a three parameter function of the form $d J_i/dx = A \tanh [(x + a)/b] \operatorname{sech}^2 [(x + a)/b]$ was used. The theory predicts qualitatively all the observed features of converter operation. In particular it predicts an optimum value for pd at which the arc drop in the plasma is a minimum. Limited quantitative comparisons also show reasonable agreement with experiments. The method may be systematically improved by assuming more complicated functional forms for the production term. (auth)

15084 INTERPRETIVE STUDIES OF THERMIONIC CONVERTER PERFORMANCE. McCandless, R. J.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif.). Contracts F33615-70-C-1108; N00014-69-C-0247. pp 227-32 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A theoretical model for describing thermionic converter performance is reviewed. The model accepts measured cesiated electrode work functions and volume physics data as input; provides a comprehensive description of transport, ionization-recombination and electrostatic sheath phenomena in the interelectrode region; and yields current-voltage characteristics, converter efficiency and plasma property profiles as output. Computed current-voltage characteristics are shown to be in good agreement with measured results for a broad range of con-

verter operating conditions. The model is employed to compute theoretical performance results for converters employing uniform surface (100)W and (110)W emitters and polycrystalline Nb collectors; and the results are compared with performance data from ten planar research diodes. It is shown that research diodes having chemically vapor deposited W emitters derived from WF_6 and WCl_6 exhibit performance in agreement with the theoretical results for (100)W and (110)W emitters, respectively. Sources of scatter in existing research diode performance data are discussed. Theoretical performance limits are established for cesiated converters with uniform surface emitters and state-of-the-art niobium collectors. Theoretical performance data indicate that at 10 mil spacings a point of diminishing returns has been reached in emitter technology and further increases in converter performance will probably be achieved most easily through advances in collector technology. (auth)

15085 COLLECTOR WORK FUNCTION MEASUREMENTS. Rufeh, F.; Gunther, B.; Lieb, D. (Thermo Electron Corp., Waltham, Mass.). Contract AT(30-1)-4125. pp 233-42 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

In the past year, data have been reported showing a discrepancy between the variations in collector work function and output voltage. This is particularly disturbing because the emitter effects are beginning to be understood, at least for 110-preferred oriented emitters. It is possible to characterize 110 tungsten emitters by bare work function and pole figure measurements and to correlate these characteristics with cesiated emission and converter power output. The collector situation is not nearly as clear. The sources of error in collector work function measurements are discussed, and criteria for minimizing their effect proposed. Work function measurements were performed on several collector surfaces using the above criteria; the results are compared with the output power of these collectors. (auth)

15086 TREATMENT OF TRANSITION REGIONS IN THERMIONIC ENERGY CONVERTERS. Clark, Melville; Lieb, David (Thermo Electron Corp., Waltham, Mass.). pp 291-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The transition region between the collisionless region adjacent to each electrode and the plasma is explored. It is shown that anisotropies of the distribution functions must be considered in trying to understand the phenomena that occur in thermionic energy converters. (auth)

15087 ELECTROSTATIC SHEATH PHENOMENA IN THERMIONIC CONVERTERS. Wilkins, D. R.; Rush, D. J. (General Electric Co., Pleasanton, Calif.). Contract F33615-70-C-1108. pp 299-304 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A generalized theoretical description of electrostatic sheath phenomena in thermionic converters is developed. The analysis goes beyond existing treatments in taking into account discontinuous distribution functions for emitted, plasma, and trapped particles; non-equilibrium ion trapping; sheath electric fields consistent with particle densities and temperatures within the sheath; and Schottky effects at the electrode surface. The resulting sheath criteria and models are applicable to both monotonic and non-monotonic sheaths, and are expressed in a form suitable for incorporation into an existing digital computer program for thermionic converter analysis. The improved treatment has been applied to thermionic converters. The results indicate the following: nonmonotonic sheaths at the emitter in the lower region of the ignited mode for electron rich conditions—this is in agreement with previous investigations; the ignition region hysteresis is probably associated with a bistable sheath at the collector; and the collector sheath is nonmonotonic for nearly all operating conditions of practical interest. The latter provides a possible explanation of reported collector work functions anomalies. (auth)

15088 NONSATURATION PHENOMENA IN THERMIONIC CONVERTERS. Hansen, Lorin K. (Atomic International, Canoga Park, Calif.). pp 305-11 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A study was made of diode non-saturation phenomena. The equations for plasma transport phenomena and the sheath-electrode-plasma interactions were integrated on a digital computer. These solutions give the I–V characteristic of the diode and the various density, temperature and current distributions in the diode as a function of position on the I–V characteristic. This information is compared with experimental data. It was found that diode non-saturation can be explained accurately in terms of ion currents from the plasma, Schottky effects at the emitter, and electron backscatter from the plasma to the emitter. All these effects are of the same order of magnitude. They are all voltage dependent and therefore produce a non-saturation effect. (auth)

15089 KINETIC THEORY OF IGNITED THERMIONIC PLASMAS. Shaw, David T. (California Inst. of Tech., Pasadena); Wu, Frank T. pp 327-36 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The spatially dependent relaxation phenomena in thermionic converters are investigated by a solution of the Boltzmann equation. The analysis given here shows that the electron distribution function during the relaxation can be described by two Maxwellian groups which eventually merge into one Maxwellian function. It is found that the constant coefficient diffusion equations are a good approximation after 5 to 7 mean-free-paths for typical plasma conditions in thermionic converters. (auth)

15090 VALIDITY OF THE LOCAL THERMODYNAMIC EQUILIBRIUM MODEL NEAR AN EMITTING ELECTRODE. Shaw, David T. (California Inst. of Tech., Pasadena). pp 337-42 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The deviation from the local thermodynamic equilibrium (LTE) in thermionic converter plasmas was studied by solving the Boltzmann transport equation and the rate equations. The role played by the escape of the resonance radiation is examined. The effect of large electric fields on the possible departure of the Saha-Boltzmann relation is discussed. (auth)

15091 THEORETICAL STUDY OF THE NETWORK RELIABILITY OF AN INCORE THERMIONIC REACTOR. Dagbjartsson, S. (Univ., Stuttgart). pp 351-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

For a converter network of an in-core thermionic reactor the operation parameters of the converters (current, voltage, emitter temperature) were investigated under the assumption that certain components had failed. These calculations are based on the I–V-characteristics. A converter failure is assumed to be a stochastic event that can occur with equal probability for every converter during the operation time. This model permits the calculation of the network reliability as a function of the redundant power at the beginning of the operation. A design proposal is presented in which the converters of various fuel elements can be connected in parallel. This design incorporates, in addition to the trilayer tube, one insulating layer and a conducting one. The conducting layer must be split up into three segments. Under the assumption that an open circuit will rapidly be changed into a short circuit a relatively high resistance of previously mentioned parallel connectors ($>10^{-3}$ Ohm) can be tolerated. For this converter network we have estimated—based on a 95% survival probability—the following: the emitter temperature of several converters will increase from 1850 to 2000°K with a probability of 10%, and the thermal power density of the reactor must be increased by approximately 10% in order to compensate the electrical power loss caused by converter failures. (auth)

15092 POWER LIMITATION OF AN INCORE THERMIONIC CELL. Haug, W.; Wolf, E. (Univ., Stuttgart). pp 357-60 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The thermal and electrical characteristics of a single incore

thermionic cell were determined on the basis of a theoretical model during the steady state operation. For this purpose, a numerical method was developed using the two-dimensional analytical solution of the heat conduction problem for the cylindrical emitter body of the cell. The limitation of electrical power output by a maximum emitter surface temperature (2000°K) and a maximum permissible thermal power (70 W/cm^2) was studied. (auth)

15093 5-kW(e) RADIOISOTOPE THERMIONIC POWER SUPPLY FOR UNMANNED ELECTRIC PROPULSION. Homeyer, W. G.; Gietzen, A. J.; Heath, C. A. (Gulf General Atomic Inc., San Diego, Calif.). Contract NAS 2-5891. pp 376-81 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The preliminary design of a radioisotope thermionic power supply for unmanned electric propulsion missions to the outer planets is described. In this design, there are 69 independent modules consisting of a thermionic converter, an emitter heat pipe to collect and concentrate heat from the isotope source, and collector and radiator heat pipes to remove heat from the collector and radiate it to space. The 69 modules are electrically connected in a series-parallel network to produce 15 volts at 5 kW(e). The 52 kW(t) of ^{244}Cm radioisotope is contained in 136 cylindrical capsules which are arranged to form a compact heat source. Heat is transferred from the capsules to the emitter heat pipes by radiation. The heat source is protected by a package of safety equipment to prevent dispersal of the isotope in the event of accidents during launch and ascent. This safety equipment is designed to be jettisoned from the power supply after hyperbolic trajectory is reached and the danger of reentry into the earth's atmosphere has passed. The mass of the 5 kW(e) power supply is 142 kg after jettison of the safety equipment and 426 kg before jettison. A launch escape system to remove the radioisotope power supply from the vicinity of a fire or explosion on the launch pad is estimated to have an additional mass of 290 kg, but can be jettisoned at low altitude and velocity where it will have little effect on the payload capability of the launch vehicle. The most important problems anticipated in the development of such a power supply are in aerospace nuclear safety and in the development of reliable components to meet the mission lifetime requirement of 72,000 hours. (auth)

15094 RADIOISOTOPE THERMIONIC GENERATOR (RTIG). Rouklove, Peter (Jet Propulsion Lab., Padadena, Calif.). Contract NAS 7-100. pp 382-7 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The unmanned exploration of the planets eventually requires the landing of spacecraft or probes on the planet surface. Basic economic considerations and weight restrictions favor the use of efficient, solar independent, lightweight, impact-resistant power packages. In some cases estimated surface conditions preclude the use of contemporary power sources. Radioisotope-heated thermionic power sources, however, may successfully operate in these conditions and fulfill the mission requirements. An analysis was performed to define the optimum thermionic converter configuration based on mission requirements and constraints, considering reliability of the system, weight, output power, output voltage, and efficiency of the complete power package and making the maximum use of present technology. The results of this analysis were compared with existing concepts. Two of these concepts were selected for further investigation, one using a heat pipe as the heat transfer and support medium, the other using small independent converters assembled in a multiconverter array. The results obtained in the development of the first concept, a multiconverter array connected to the isotope power source through a heat pipe, are presented. (auth)

15095 OPTIMIZATION OF THE QUASI-VACUUM MODE THERMIONIC CONVERTER. Mayer, Morton S.; DeSteese, John G.; Saaski, Elric W. (McDonnell Douglas Astronautics Co., Richland, Wash.). pp 388-94 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Quasi-vacuum mode thermionic energy conversion is the basis of the developing ISOMITE thermionic radionuclide battery concept now being considered for application in space and remote terrestrial power supplies. Two computer codes are described which calculate optimum converter design characteristics for converter modules in the power range from 10 mW(e) to 10 W(e). The codes account for all components of the converter thermal balance except back-emission heating, which appears to be negligible in optimized converters. Use of the computer codes has demonstrated a correlation of converter parameters with emitter thermal flux density. For many space-applicable converters operating in zero gravity, the correlation may be used directly for design purposes. For terrestrial devices where area-independent emitter support losses occur, the basic flux correlation is readily modified. The influence of surface properties on converter efficiency is illustrated by a theoretical comparison of converter output using electrode combinations of tantalum, tungsten, oxygenated tantalum, oxygenated tungsten, and iridium. An experimentally observed surface temperature dependence of the Ta–O–Cs work function minimum region is described and correlated for input to the converter optimization routine. Data from a laboratory test device with oxygenated tantalum electrodes show general agreement with calculation. (auth)

15096 PARAMETRIC PERFORMANCE REVIEW OF THE MULTICELL GENERATOR. DeSteese, John G.; Barsell, Arthur W.; Johnston, Richard P.; Mayer, Morton S. (McDonnell Douglas Astronautics Co., Richland, Wash.). pp 395-403 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Parametric performance and characteristics were calculated for space power generators composed of low-temperature, integrally-fueled, radionuclide-thermionic converter arrays operating in a quasi-vacuum mode. Dominant system variables, including the choice and influence of thermionic surface parameters, fuel form, emitter geometry, helium management, generator reliability, and nuclear safety requirements were considered. Generator design and material selection reflect current and/or credible near-term technology. This study shows that plutonia-fueled multicell generators in the power range from 100 to 200 W(e) achieve a specific power of approximately 4 W(e)/lb and overall conversion efficiency in excess of 7%. A modular "building-block" approach to generator design using a basic ISOMITE converter size is acceptable over a wide range of power. A brief review of credible future technology indicates remarkable growth potential of the concept. In combination with anticipated developments in thermionic surfaces, fuel capsule fabrication, and aeroshell technology, high power density fuels would permit specific power in excess of 20 W(e)/lb and efficiencies approaching 10%. (auth)

15097 EXPERIMENTAL DETERMINATION OF CESIUM VAPOR CONDUCTION AT TEMPERATURES LESS THAN 1000°K. Saaski, E. W.; Griffin, B. I. (McDonnell Douglas Astronautics Co., Richland, Wash.). pp 404-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The thermal conductivity of cesium gas was measured with cesium reservoir vapor pressure from 0.001 to 2.0 torr and surface temperatures of 500 to 900°K. A miniature vacuum-mode thermionic diode with oxygenated tantalum electrodes was the experimental vehicle. The diode was cesiated by attachment to a continually operating cesium still; the pressure of cesium was varied by varying the operating temperature of the still. A mass spectrographic analysis of the cesium vapor was performed during the cesiation process using a residual gas analyzer, and the main impurities were shown to be hydrogen and hydrocarbon gases, present at a total pressure of $<10^{-6}$ torr. Diode collector temperature was measured using standard thermocouples; the emitter temperature was calculated from diode open circuit voltage and the collector work function. Data are presented on the accuracy of the latter technique. Heat transfer was corrected for radiation and support conduction and correlated with expressions derived for transition regime gas conduction. Conduction data are compared to existing data in the literature, and shown to agree favorably with kinetic theory in the free-molecular flow regime if a net surface thermal accommodation coefficient of 1.0 is assumed at beginning-of-life and 0.50 after one month at 775°K mean temperature. The experimental dependence of a net accommodation coefficient on mean surface temperature is less than 5% over the temperature range investigated. (auth)

15098 PLASMA-ANODE TUBE IN METAL–CERAMIC ENVELOPE. Shimada, K.; Cassell, P. L. (California Inst. of Tech., Pasadena). pp 410-13 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York;

Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Plasma-anode tubes have been conveniently employed for evaluating electron emission capabilities of various metals in contact with alkali–metal vapor. A similar tube has been effectively used to study the effect of oxygen that coabsorbs with cesium vapor on the electron emission of tantalum electrodes. A conventional tube is made in a glass envelope, which is simple to construct, and in which it is easy to maintain a large volume (≈100 cc) of plasma where sample electrodes are placed. However, the glass tube is limited in operating temperatures mainly by the glass-to-metal seals (which are particularly susceptible to reactions with cesium vapor), and by limitations in the current-carrying capacity of the lead-throughs. A tube in a metal-ceramic envelope has been developed to reduce these limitations and to increase the capability of the tube as a test vehicle for electron-emission studies. The outside wall, which serves as a vacuum envelope, is made of stainless steel; the inside wall, which provides an insulating surface for the plasma, is an alumina cylinder. A pair of discharge electrodes, the sample probes, and two sapphire view ports are mounted on demountable flanges with copper gaskets. This tube can be baked out and operated at much higher temperatures (≈400°C) than the glass tubes. Also, interchangeability and repairability of the electrodes is provided by making them demountable. During the first phase of the experiments with the metal tube, argon gas was used (in place of cesium) to demonstrate the tube's capability to contain a plasma. The plasma was examined with a movable Langmuir probe that was insulated with a layer of metal oxide. Results indicated that the argon plasma was successfully maintained in the tube and that its volume was large enough to accommodate as many as three sample probes for the emission study. Results also indicated that the thin metal-oxide that was formed as an insulator for the Langmuir probe was quite satisfactory in providing a good insulation without distorting the plasma conditions near the probe. (auth)

15099 CHARACTERISTICS OF CYLINDRICAL CONVERTERS HAVING NON-UNIFORM EMITTER TEMPERATURE. Shimada, K.; Rouklove, P.; Cassell, P. (California Inst. of Tech., Pasadena). pp 441-5 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

In support of the reactor thermionic program at JPL, two nuclear-type converters having a cylindrical geometry were tested out-of-core for their thermal and electrical characteristics. One of the two converters was investigated for the emitter heat balance, temperature distribution and work function. The temperature variation along the emitter, which was as large as 150°K, depended upon the output current of the converter. However, the average temperature was found to be calculable from the measurable quantities such as the heating power inputs, average work functions and the electron cooling. It is therefore possible to arrive at an estimate of emitter temperatures of an in-pile converter with a good accuracy if the thermal balance measurements are made out-of-core while emitter thermocouples are still reliable. The other converter was tested for "emitter temperature run-away" and the mode of failure resulting from an over-temperature operation. The objective of this test was to reveal any obvious weakness in the construction that might cause a catastrophic failure of the generator system in the event of an electrical open circuit or a depletion of cesium in the converters. The test results indicated that "emitter temperature run-away" did not occur with this converter, but that during over-temperature operation a failure did occur at the emitter-centering mechanism. The melting of an emitter centering pin caused an intermittent short between the emitter and the collector. An uneven heating of the emitter that resulted from a thermal feedback between the bombarding filament and the emitter is considered to be the primary cause of the formation of hot spots. A rapid loss of cesium that would have been catastrophic did not occur. (auth)

15100 EMITTER TEMPERATURE DEPENDENCE OF LOWER MODE CURRENT. Gunther, B. (Thermo Electron Corp., Waltham, Mass.). Contract AT(30-1)-4125. pp 446-52 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Ignition current measurement was suggested as a useful technique for determination of emitter temperature. Data obtained from two converters with substantially different emitters (110) and (100) tungsten were in good agreement, showing that the emitter work function does not influence the deduced emitter temperature (within 25°K). Ignition current was essentially independent of collector temperature and, therefore, of collector work function, and was an inverse function of interelectrode spacings. The above results confirm the theoretical predictions. It was found, however, that the ignition current is a linear function of emitter temperature. This is in contrast with the theoretical analysis, which predicts an exponential relation with inverse temperature. This difference corresponds to an error of 50°K in emitter temperature determinations. Ignition current was found to be a sensitive function of interelectrode spacing. A 2 mil error at the spacing of 10 mils can result in an error of 50°K in emitter temperature. If the spacing is known, the emitter temperature can be determined within 25°K using the experimental correlation. (auth)

15101 REACTOR SIMULATOR RUNS WITH THERMIONIC DIODE KINETICS EXPERIMENT. Gronroos, H. G.; Sawyer, C. D. (Jet Propulsion Lab., Pasadena, Calif.). Contract NAS 7-100. pp 453-61 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The operation of the thermionic diode kinetics experiment with an analog computer nuclear reactor simulator in the loop is described. The open loop response of the simulator to system perturbations such as reactivity insertions, electric load perturbations, the effects of diode failure, and reactor startup are discussed. The obtained temperature and reactivity responses indicate that for the expected range of temperature coefficients of reactivity no particular nuclear reactor kinetics problems are present. The self-regulation is unsatisfactory, however, and a controller is needed in the loop. (auth)

15102 THERMIONIC PERFORMANCE OF FLUORIDE CVD TUNGSTEN–NIOBIUM CONVERTER. Rufeh, R.; Lieb, D. (Thermo Electron Corp., Waltham, Mass.). Contract AT(30-1)-4125. pp 462-70 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Fluoride vapor-deposited tungsten has been shown to form a mechanically stable and easily fabricated thermionic emitter structure. It has been used with a niobium collector in many fixed-spacing hardware converters for both in-pile and out-of-pile life tests. A complete performance map of this electrode pair showing the dependence of output power on converter parameters has not been available. Therefore, parametric data are obtained in a research, variable-spacing thermionic converter for a wide range of converter parameters. Attempts were also made to measure the cesiated work function of the electrodes. The transient effects observed showed that, unlike other materials, the emission characteristics of this emitter depend on its temperature history preceding the test. This dependence was attributed to the diffusion of an impurity element, possibly carbon, in the fluoride tungsten material to the emitter surface. It is known that the performance of fluoride tungsten emitters is considerably lower than that of the other emitters (e.g., chloride tungsten). The present data indicate that the performance at low temperatures (less than 1800°K) would have been even lower if additives were not diffusing through the emitter. The data presented are believed to be representative of fluoride tungsten emitters. (auth)

15103 THERMIONIC PERFORMANCE OF CVD TUNGSTEN EMITTERS WITH SEVERAL COLLECTOR MATERIALS. Lieb, D.; Rufeh, F. (Thermo Electron Corp., Waltham, Mass.). Contract AT(30-1)-4125. pp 471-80 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

There has been considerable interest in vapor-deposited tungsten emitters because of their structural and thermionic properties. An evaluation of the performance of these emitters in combination with various collectors will help to determine the most suitable collector material for thermionic reactor and other power conversion applications. Three chloride vapor-deposited tungsten emitters were selected as being very similar on the basis of their bare work functions and pole figures. Two of these were installed in variable spacing converters, one with a niobium collector and one with a sublimed molybdenum collector. The thermionic performance of these two converters is presented and their performance compared with that of sev-

eral other converters having ⟨110⟩ and ⟨100⟩ tungsten emitters and various collector materials. The converters tested are all similar in design and use the same procedures for processing, outgassing, and cesiating. (auth)

15104 PERFORMANCE OF CYLINDRICAL CONVERTER WITH DEEP ETCHED TUNGSTEN EMITTER. Samstad, G. I.; Danko, J. C.; Levin, H. A. (General Electric Co., Pleasanton, Calif.). Contract NAS 3-8511. pp 481-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A method of electroetching chemically vapor deposited tungsten with a preferred (100) crystal orientation to yield large facets of (110) crystal faces was developed and preliminary results presented at the 1969 Thermionic Conversion Specialist Conference. This technique was used to prepare a cylindrical emitter of chemically vapor deposited tungsten produced by the hydrogen reduction of tungsten hexafluoride. The emitter was characterized by x-ray diffraction, etch pits and vacuum work function measurements. This emitter was used in an out-of-pile converter utilizing a niobium collector with a 12 mil interelectrode spacing. Extensive performance mapping was carried out to characterize the converter performance. The converter was then life tested for 5000 hours at 1700°C and at an average output power density of 7.4 W/cm^2. Cesiated electrode work functions were also measured during this time. Following the life testing, performance mapping was again obtained, demonstrating the stability of the converter performance. The performance results and post-test examination data are presented. The performance is compared with two converters of identical design but with preferred (110) chloride vapor deposited tungsten emitters, niobium collectors and 10 mil spacing. Also, comparisons are made with planar research converters of similar spacing and collector material for both (110) and (100) emitter surface crystal orientations. (auth)

15105 COMPUTER-ACQUIRED PERFORMANCE MAP OF AN ETCHED-RHENIUM, NIOBIUM PLANAR DIODE. Lancashire, Richard B. (Lewis Research Center, Cleveland). pp 487-91 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A fixed-spaced planar diode with a guarded collector has been performance-mapped in a multistation facility which is connected to a centralized computer data acquisition system. The etched-rhenium emitter was separated from the niobium collector by 10 mils. The use of the computer system allowed off-design as well as on-design conditions to be observed. Emitter temperatures from 1550 to 2050°K were tested. Collector temperatures were varied from 750 to 1180°K, and cesium reservoir temperatures were varied from 525 to 650°K. The data are presented on J,V and P,V plots. The collection of the many current, voltage curves was achieved by sweeping the diodes over a period of approximately 10 milliseconds with a variable electronic load controlled by the central digital computer. (auth)

15106 THERMIONIC PERFORMANCE OF CVD CHLORIDE TUNGSTEN AND SUBLIMED COATED MOLYBDENUM ELECTRODES IN CYLINDRICAL HEAT PIPE DIODES. Ernst, Donald M. (Thermo Electron Corp., Waltham, Mass.). pp 492-7 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Five cylindrical diodes were built and tested to establish an average thermionic performance for the emitter-collector electrode pair of CVD chloride tungsten and sublimed coated molybdenum. The diode design employs an arc cast tungsten heat pipe to heat the emitter to maintain a uniform emitter temperature. The CVD chloride tungsten is 0.02 inch thick and is deposited directly on the wall of the heat pipe. The collector consists of a niobium substrate coated with 0.003 inch thick molybdenum. The diode has an area of 20 cm^2 (1.33 inch long × 0.750 inch diameter) and a nominal interelectrode spacing of ten mils. Performance data are presented by means of cesium family and collector family I–V curves for emitter temperatures from 1600 to 1900°K. (auth)

15107 LONG TERM OPERATION OF OUT-OF-PILE THERMIONIC CONVERTERS. Yates, M. K.; Fitzpatrick, G. O.; Kay, J. Jr. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 498-507 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrieal and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Two unfueled converters are being tested out-of-pile to determine performance levels and long-term performance stability. One, LC-9, has been operated stably over three years (28,000 hours) at an average electrode power density of 8.0 W/cm^2 and an average emitter temperature of 1700°C. This diode has a duplex emitter (tungsten deposited from WCl_6 over a substrate deposited from WF_6) with a vacuum work function of 4.8 eV. The other diode, OC-A4, has operated over 10,000 hours at an average electrode power density of 6.8 W/cm^2 and an average emitter temperature of 1760°C. It contains a fluoride tungsten emitter and a graphite cesium reservoir that is operating at 820°C. (auth)

15108 INTEGRATED CESIUM RESERVIOR THERMIONIC CONVERTER FOR IN-PILE APPLICATIONS. Shroff, A. M.; Imbert, F. pp 508-12 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

To build a thermionic nuclear reactor, it is necessary to have thermionic fuel elements TFE containing a certain number of thermionic converters placed in series. The TFE can use a common cesium reservoir for all the diodes or individual integrated cesium reservoir modules. In the latter case, all the diodes are independent and can be pumped and tested separately before mounting in series to constitute the TFE. In all cases, for optimum performance self-regulation of the diodes is desirable. This self-regulation depends not only on the cesium absorbent used, but also on the temperature of the collector coolant. A theoretical model was developed for describing the in-pile performance of four types of cesium reservoirs at varying coolant temperatures. For the calculations it was concluded that: for collector coolant temperatures of 650°K and below a common cesium reservoir (liquid or graphite cesium) is best; for intermediate and high collector coolant temperatures, the individual graphite cesium reservoir matched to the emitter and the collector or only to the collector was more promising; and in all cases, the dry cesium vapor reservoir is the ideal solution. (L.C.L.)

15109 DESIGN, FABRICATION, AND TESTING OF A FULL-LENGTH EXTERNAL-FUEL THERMIONIC CONVERTER. Schock, A.; Raab, B.; Giorgio, F. (Fairchild Hiller Corp., Farmingdale, N. Y.). pp 517-32 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The development of a double-ended full-core-length external-fuel converter, a proto-typical fuel module for a 200- to 300-kW(e) thermionic reactor, is described. The converter design is based on a revolver-shaped tungsten emitter body, with six peripheral fuel chambers loaded with enriched UO_2 pellets. The columbium collector is water-cooled through a sub-atmospheric adjustable-pressure helium gap. The converter employs graded metal-ceramic seals, and its double-ended construction is made possible by bellows to compensate for differential axial expansion. Fission gases are vented from the fuel chambers and collected in an accumulator designed for continuous monitoring of the pressure buildup. Component fabrication, assembly sequence, and joining methods are described; also the test procedures, and the converter load control. All tests are performed in vacuum. During in-pile testing, the fuel is triply contained, with thermal insulation between the secondary and tertiary containers. Before insertion in-pile, the fully fueled converter is being qualification-tested by rf-induction heating, using a specially-developed high-vacuum rf-feedthrough. To date, this out-of-pile test has operated for over 1000 hours, producing a total of 480 kilowatt-hours, with a peak output of 530 watts, or 7.1 W/cm^2, at a conversion efficiency of 11.5%. (auth)

15110 DESIGN, FABRICATION, AND TESTING OF EXTERNALLY CONFIGURED THERMIONIC DIODES. Ernst, D. M. (Thermo Electron Corp., Waltham, Mass.). Contract 952469. pp 533-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

An electrically-heated, externally-configured thermionic diode with an active electrode area of 84 cm^2 was designed, fabricated, and tested. The ten-inch long emitter utilized the mandrel side

of CVD fluoride tungsten for the electrode surface. The collector was niobium-1% zirconium coated with a few microns of molybdenum. The measured diode output was approximately 5 watts/cm^2 at an emitter temperature of 2000°K. Additional work is currently underway to design and develop a prototype fueled diode for further test and evaluation. (auth)

15111 DEVELOPMENT OF THERMIONIC DIODES FOR ISOTOPE-FUELED GENERATORS. Teagan, W. Peter (Thermo Electron Corp., Waltham, Mass.). pp 539-45 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The design, testing, and performance of a planar diode designed for use in a 100-watt thermionic generator fueled with curium-244 are described. The diode had an etched rhenium–molybdenum electrode pair and a collector area of 13.3 cm^2, and was designed to operate at 1863°K with a spacing of 5 mils. Results are given from dynamic sweep, long-term steady state, and calorimetric data taken during diode testing. Because of the importance of efficiency for electrical generators using isotopes as the fuel source, a study was undertaken to determine possible approaches for improving diode efficiency further. The results of this study are discussed with particular attention given to: improving diode electrical performance by use of oxygen additives, and reducing interelectrode radiation losses by the proper choice and processing of electrode materials. These studies indicated that diode efficiencies of 20% are possible at an emitter temperature of 1900°K. (auth)

15112 FABRICATION AND EVALUATION OF AN OUT-OF-CORE THERMIONIC CONVERTER MODULE. Kroeger, Erich W. (Lewis Research Center, Cleveland). pp 546-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The mechanical design, fabrication procedure, and preliminary test results obtained for an out-of-core thermionic converter module, heated and cooled by heat pipes, are presented. The mechanical and thermal evaluation of critical module components, including the cermet insulator, converter end structure, and collector heat pipe in the form of a vapor fin radiator, is also discussed. (auth)

15113 STATUS OF EMITTER HEAT PIPE DEVELOPMENT AT ISPRA. Busse, C. A.; Geiger, F.; Quataert, D. (EURATOM-CCR, Ispra, Italy). pp 550-5 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The development work on heat pipes for operation around 1600°C is concentrated on Li systems mainly for two reasons: Li has a very high heat transfer capability at moderate vapor pressures, and a W/Li heat pipe has shown that minimum corrosion in early screening tests of 15 heat pipe combinations comprising Nb–1Zr, Ta, CVD–W as wall material and Bi, Pb, Tl, Li, Ba as working fluids. Successful corrosion inhibition has been demonstrated in 1000 hour tests with Nb–1Zr/Li at 1500°C and Ta/Li at 1600°C by sufficient deoxidation. A W–26Re/Li heat pipe has passed 6000 hours of operation at 1600°C with an average heating rate of 100 W/cm^2 without showing any signs of deterioration. For temperatures around 2000°C Ag heat pipes are being studied. A first test of a W–26Re/Ag heat pipe showed after 1000 hours at 2000°C with an average heating rate of about 150 W/cm^2 moderate mass transport of an unusual pattern, which can not yet be explained. (auth)

15114 POST-TEST EXAMINATIONS OF A LONG-LIFE THERMIONIC CONVERTER. Clemot, M.; Gayte, B.; Lebourg, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 556-61 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Post-test examinations performed on a thermionic converter designated CAV 139 are described. This converter failed at 9,000 hours test duration. The device delivered 7.5 watts/cm^2 with 12.5% measured efficiency. Neutron radiography and gammagraphy techniques were used to examine emitter and collector alignment. Visual examination of the emitter showed that failure of the converter was caused by localized protrusions on the emitter and collector surfaces. It appeared that the collector surface was covered by evaporated tungsten from the emitter. The results of metallographic, spectrographic, and chemical analysis performed on emitter, collector, metal ceramic seal, brazing, and alumina spacers are reported. Special attention was paid to: Mo–W emitter and collector by using electron probe and electron scanning microscope techniques, and chemical analysis of cesium content in converter components dealing with cesium consumptions in alumina, molybdenum, tungsten and copper–nickel brazing. (auth)

15115 VENT FOR NUCLEAR-THERMIONIC FUEL ROD. Houston, John M. (to Secretary of the Air Force). U. S. Patent 3,629,063. 21 Dec 1971. Filed 23 Sep 1968.

Cesium vapor, ordinarily lost to space, is carried through a venting tube to an area where a lowered temperature causes it to condense onto a wick and to be carried by capillary action back to an area of sufficiently high temperature to vaporize it and return it to the Cs vapor region of the fuel rod. The condensing, wicking and evaporation are effected by telescoping sections of a hollow tube. The vapor is conveyed through the tube to a cooler area, is condensed on a wick inside the outer tube and is vaporized from the wick on the outside of the inner tube. (Official Gazette)

15116 EFFECT OF NON-MAGNETIC GAPS BETWEEN THE MAGNETIC CIRCUIT SEGMENTS ON THE CHARACTERISTICS OF CONTROLLED HIGH-POWER REACTORS INTENDED FOR POWER PLANT SYSTEMS. Chernovets, A. K.; Sokolov, S. E. (Leningrad Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Energ.; No. 6, 1-5(Jun 1970). (In Russian).

The main air gap in a controlled reactor with a rotating magnetic field as a rule is 0.5 to 2.0 mm to the side, and the presence of the joints between the segments of magnetic conductors influences significantly the magnitude of current flow, the regulating range, and power of the winding coefficient control. Calculations of electromagnets must take into account the influence of the joints and consider the equivalent gap, which in a high-energy reactor can be even larger than the main gap. It is shown that consideration of the joints reduced the control range 20 to 30% and increased the consumption of active materials. (tr-auth) (INIS)

Facilities and Equipment

Refer also to abstracts 15116, 15192, 15631, 15670, and 15757.

15117 (CEA-CONF–1881) THE OTHELLO LOOP. Colomez, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1971. 12p. (In French). (CONF-710628–3). Dep. NTIS (U. S. Sales Only).

From Euratom conference on radiation devices; Cadarache, France (10 Jun 1971).

The Othello loop, which was designed to irradiate structural elements in a CO_2 environment, has been modified to test fuel elements under their nominal operating conditions in high temperature reactors. The part of the core envisaged for these experiments presents a flux of 2×10^{14} n/cm^2/sec (thermal and fast E > 1 MeV). During the power cycling, the loop may be placed outside the reactor vessel, the removal from the core being effected only when the reactor is shut down. The immersed part is connected to an out-of-pile circuit by electrical connections and gas piping contained in pressurized metallic tubing. The current version has the following characteristics: channel diameter = 41 millimeters, maximum sample length = 400 millimeters; coolant gas: He at 60 bars with a mass flowrate of 33 g/sec; cooling power of 25 kW (maximum linear power of flux = 700 W/cm); in-pile and out-of-pile He volumes 1 m^3 and 8 m^3 at STP respectively. (France)

15118 (CONF-680614–, pp 258-68) NEW Y-12 DRY ROOM FOR THE METALLOGRAPHY OF HYGROSCOPIC MATERIALS. Petretzky, Paul B. (Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The new dry room has an area of ~350 ft^2 and is capable of maintaining a relative humidity of ~3%. Equipment and procedures for metallographic investigations of hygroscopic materials are described. (T.F.D.)

15119 (HEDL-SA–182) MANAGEMENT DECISIONS ON ENGINEERING INFORMATION. Hayward, B. R.; Shober, F. R.; Arnovick, G. N. (Hanford Engineering Development Lab., Richland, Wash.). [1971]. Contract AT(45-1)-2170. 16p. (CONF-711116–1). Dep. NTIS.

From thirty-fourth meeting of American Society for Information Science; Denver, Colo. (7 Nov 1971).

A series of management decisions are presented for the design, operation, and use of a specialized technical information center for engineering design and development. The education of technical managers participating in an information system is a cricital requirement for the effective use of these centers as tools of industry. The unique aspects of the LMFBR Cladding Information Center are the collection, storage, and processing of high quality, raw technical data. This center, designed by users for users, is a simple, dynamic, technical data center that will be typical of this coming decade. (auth)

15120 (RDT-E-3-2-T(8-69)) CENTRIFUGAL: FREE-SURFACE SODIUM PUMP WITH ELECTRICAL DRIVE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1969. 71p. LMEC.

A standard prescribing requirements for centrifugal free surface sodium pump with electrical drive for nuclear and associated applications is presented. (J.R.D.)

15121 COLD TRAP. Pohl, Lawrence E.; Roy, Prodyot (to United States Atomic Energy Commission). U. S. Patent 3,618,770. 9 Nov 1971. Filed 4 Feb 1970.

A device is described for collecting and storing impurities found in high-temperature sodium or other liquid metal loops of nuclear reactors. The effectiveness of nucleating and precipitating these impurities is increased by electromagnetic stirring of the cooled sodium. The electromagnetic stirring action of the sodium or other liquid metal is accomplished with a polyphase rotating magnetic field. (Official Gazette)

15122 DUST FILTER APPARATUS UTILIZING GRANULAR SOLID FILTER MEDIA. Edwards, Edwin F.; Fukuzawa, Jun; Solnick, Robert L. (to United States Atomic Energy Commission). U. S. Patent 3,621,639. 23 Nov 1971. Filed 26 Nov 1969.

Apparatus is described for filtering dust from a stream of gaseous medium using granular siliceous filter media with provision for regeneration by means for immersion of media in water with controlled gas flow agitation, followed by means for drying with heated gas flow. (Official Gazette)

15123 WELDING PROBLEMS ENCOUNTERED IN THE MANUFACTURE OF THE LARGE BUBBLE CHAMBER AT CERN. Feldmann, M. (European Organization for Nuclear Research, Geneva); Forcinal, F. Schmitt, J.; Jacquemound, J. Soudage Tech. Connexes; 25: No. 9, 359-79 (Sep 1971). (In French).

The manufacture of cryostats and vacuum tanks for the superconducting coils of the large bubble chamber at CERN was allocated to the Alsthom society. Manual welding with coated electrodes was used for the joints which could not be automatically welded and inspected for possible repairs. The use of automatic processes proved to be quite feasible for vertical welding with slag or electron beam welding on large stainless steel (316L) constructions. The adapting of these processes to the welding of thick materials and circular joints obviously required important technological advances. The apertures were effected by plasma cutting. The procedures adopted, the associated problems, the development, and the controls effected, are described. (France)

15124 PARTICLE SIZE ANALYSIS IN INDUSTRIAL HYGIENE. Silverman, Leslie; Billings, Charles E.; First, Melvin W. Monograph Series on Industrial Hygiene. New York; Academic Press, Inc. (1971). 330p. $17.00. (TID-25871).

Methods used in industrial hygiene, health physics, and air pollution control for particle sampling and size analysis of solid and liquid airborne matter, fine bulk powders, and particle deposits in tissues are described. Discussions are included on particle properties of importance for direct (e.g., microscopic) and indirect (e.g., sedimentary) analytical methods, automatic sizing devices, and sizing data processing and interpretation. Techniques associated with health and safety problems arising from particulate use and exposure are emphasized along with the range of application and utility of these techniques. Details of practice are also included to show how to obtain a representative sample of airborne or deposited material, and how to prepare reliable analyses. (J.R.D.)

15125 RE-EXAMINATION OF HEAT PIPE STARTUP. Sockol, Peter M.; Forman, Ralph (Lewis Research Center, Cleveland). pp 571-3 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

In a lithium heat pipe, high-operating temperatures permit visual observation of the temperature profile during startup. Cotter's model of the startup process is reassessed in the light of these observations. The model is modified by moving the sonic point to the end of the hot zone and including the opposing effects of wall friction and condensation on the flow. Transient measurements have been made on a lithium heat pipe for startup to temperatures in the range 1000 to 1400°C. As predicted by the theory, the temperature of the hot zone is fairly independent of the power input to the evaporator until the hot zone reaches the end of the pipe. The hot zone temperature predicted by the theory is 50 to 80°C higher than the measured value with up to 30°C of the discrepancy attributable to the measurement. (auth)

15126 MINUTE PARTICLE SEPARATOR USING ELECTRONICALLY SENSED VOLUME (26 Mar 1971) (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-2164).

14 drawings.

The device fractionates a mixture of microscopic particles according to small differences in their volume. A dilute suspension of the particles passes through a sensor within which the volume of each particle is electronically measured. The suspension then emerges into the air as a liquid jet, which breaks into a large number of individual droplets, thereby isolating the suspended particles. The droplets containing particles of the desired volume are electronically charged and electrostatically deflected into suitable receptacles. The device has been used to fractionate polystyrene spheres and biological cells such as white blood cells. For details see TID-4100 Suppl 68. (F.S.)

15127 MOISTURE SEPARATING AND STEAM REHEATING APPARATUS. (to Westinghouse Electric Corp.). British Patent 1,255,512. 1 Dec 1971. Priority date 30 Sep 1968, United States.

An apparatus is described for separating and reheating moisture from steam produced by reactors to operate turbines. An axially elongated tubular casing is provided which incorporates equipment for steam distribution, moisture removal, and steam reheating. The casing is connected to an inlet for moisture-laden steam and a return for reheated steam. (J.R.D.)

Heat Transfer and Fluid Flow

Refer also to abstracts 15113, 15387, 15729, 15783, and 17166.

15128 (ANCR-1026) ASTEM: A COLLECTION OF FORTRAN SUBROUTINES TO EVALUATE THE 1967 ASME EQUATIONS OF STATE FOR WATER/STEAM AND DERIVATIVES OF THESE EQUATIONS. Moore, K. V. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971. Contract AT(10-1)-1375. 24p. Dep. NTIS.

ASTEM is a modular set of FORTRAN IV subroutines to evaluate the state equations of liquid water and steam as published by the American Society of Mechanical Engineers (1967). Any thermodynamic quantity including derivative properties can be obtained from these routines by a user supplied main program. As provided, the ASTEM package includes a sample main program and requires 68K bytes of core storage (double precision) on the IBM 360/75. (auth)

15129 (ANL-7884) ON THE INCIPIENT BOILING OF SODIUM AND ITS APPLICATION TO REACTOR SYSTEMS. Holtz, Robert Edward (Argonne National Lab., Ill.). Nov 1971. Contract W-31-109-eng-38. 126p. Dep. NTIS.

Thesis. Submitted to Northwestern Univ., Evanston, Ill.

Experimental measurements of incipient-boiling superheats have been obtained in a sodium pool-boiling apparatus which employed an electromagnetic pump as the means for applying pressure to the system. The sodium used for these tests was taken from the EBR-II primary system. The experimental results have supplied the following information: a large incipient-boiling superheat can result in the boiling surface losing a previously established pressure-temperature history; when the pressure-temperature history is reestablished for at least 20 min prior to each test run, the incipient-boiling superheats show good agreement with the pressure-temperature modeling technique if a ratio for the receding to advancing radii of curvature of about 0.34 is employed; the incipient-boiling superheat appears independent of the approach to boiling; and the presence of a partial pressure of inert gas in the surface cavities can significantly lower the incipient-boiling superheat. An analysis of the application of the incipient superheat model to reactor systems shows the key roles of the pressure-temperature history and the partial pressure of inert gas in the surface cavities upon the incipient-boiling superheats during various postulated reactor accidents. Calculations demonstrate that relatively high incipient-boiling superheats occur during various postulated accidents in pot-type

reactors, while relatively small incipient superheats occur during postulated accidents in loop-type reactors. (auth)

15130 (CEA-CONF-1885) MIXED CONVECTION IN SODIUM. Wendling, M.; Ricque, R.; Martin, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1971]. 23p. (CONF-710942-1). Dep. NTIS (U. S. Sales Only).

From fourth international seminar on heat and mass transfer in liquid metals; Trogir, Yugoslavia (6 Sep 1971).

Experimental heat transfer data obtained in a vertical asymmetrically heated rectangular channel at low Peclet number are presented. The effect of body forces is well correlated with the G/Re ratio and good agreement is found with previously published Russian data. Measurements of transverse temperature profiles show that a fully developed flow may be defined in the last part of the channel. (France)

15131 (CEA-CONF-1889) MIXED CONVECTION IN LIQUID METALS. Martin, R.; Ricque, R.; Vernier, Ph.; Wendling, M. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1971]. 36p. (In French). (CONF-710939-1). Dep. NTIS (U. S. Sales Only).

From Conference on natural and mixed convection and its industrial application; Ermenonville, France (13 Sep 1971).

Mixed convection in sodium was studied experimentally as part of a research program on the thermohydraulics of integrated sodium-cooled reactor vessels. The experimental device consists of a closed circuit which includes a test section. The results obtained for longitudinal and transverse temperature profiles and thermal exchange coefficients are presented. (France)

15132 (CEA-CONF-1939) CRITICAL FLOW EXPERIMENTS IN A FORCED CONVECTION BOILING SODIUM LOOP. Costa, J.; Charlety, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1971]. 18p. (In French). (CONF-710942-2). Dep. NTIS (U. S. Sales Only).

From fourth international seminar on heat and mass transfer in liquid metals; Trogir, Yugoslavia (6 Sep 1971).

Consequences of critical flows occurring in a flashing facility and in a forced convection boiling loop are presented. A method is derived for determining if critical conditions are reached at the exit of a boiling test section in a forced convection loop. The method was used on a boiling sodium loop and critical flow rates data are presented. (France)

15133 (KFK-1433) PRESSURE LOSS MEASUREMENTS IN A ROUGHENED ROD BUNDLE. Maubach, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jun 1971. 28p. (In German). Dep. NTIS (U. S. Sales Only).

A method of the interpretation of pressure drop measurements with bundles of rods with artificially roughened surfaces is described. Pressure drop measurements have been performed with a bundle of 19 roughened rods contained in a smooth hexagonal channel with flow of helium and air, respectively. The universal parameters, which have been derived from these measurements, have been compared with pressure drop measurements on rough surfaces in tubes and annuli. It is possible to calculate the pressure drop and the flow distribution in artificially roughened rod bundles by the described method, if the shape of the artificial roughness is assumed. (auth)

15134 (LA-4740) REDUCTION OF MESH TANGLING IN TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMICS CODES BY THE USE OF VISCOSITY, ARTIFICIAL VISCOSITY, AND TTS (TEMPORARY TRIANGULAR SUBZONING FOR LONG, THIN ZONES). Browne, Philip L.; Wallick, Karl B. (Los Alamos Scientific Lab., N. Mex.). Nov 1971. Contract W-7405-eng-36. 16p. Dep. NTIS.

Several related studies of compressible, two-dimensional Lagrangian hydrodynamics are described. Reduction of mesh tangling, particularly in problems that have long thin zones, is emphasized. The topics discussed are: a general method of deriving the momentum equation in difference form, incorporation of the viscosity-stress tensor into this method, use of the viscous-stress tensors to add a two-dimensional form of the Richtmyer von-Neumann artificial viscosity, and a device called "temporary triangular subzoning" (TSS) to delay the transmittal of artificial signals that lead to oscillations and tangling in long, thin zones. The last two methods have not been tested thoroughly, but have certainly eliminated a great deal of the twisting and tangling in several test problems. These methods also retain spherical, cylindrical, and plane symmetry in problems of that type. The last proposal, the TTS, may introduce some stiffness into the mesh, but it is hoped that with further experimentation this can be reduced. The purpose is to present the basic ideas which seem sound and worth consideration. (auth)

15135 (RD/B/N-2106) EFFECT OF RIB SHAPE AND SPACING ON CONDUCTIVITY CORRECTIONS TO RIBBED SURFACE HEAT TRANSFER DATA. Watts, J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1971. 21p. Dep. NTIS (U. S. Sales Only).

The effect of thermal conductivity on the heat transfer performance of a number of rib-roughened surfaces was computed using previously measured heat transfer coefficient distributions. The calculations show that the rig-to-reactor performance correction is smaller for some refined surfaces than for the standard AGR roughness. It follows therefore that the improvement to be obtained by using such a refined surface is greater (typically by 3%) than would at first appear from rig tests. (auth)

15136 (RLO-2214-7) NATURAL CONVECTIVE FLOW BETWEEN ISOTHERMAL CONCENTRIC SPHERES. Yin, Shiu-hau (Montana State Univ., Bozeman). Mar 1972. 128p. Dep. NTIS. Thesis.

Natural convective flow of air and water between isothermal concentric spheres was experimentally investigated. Different visualization techniques were utilized for each specified fluid. A special visualization technique was developed for water as the working medium in this study. The visualization of the flow pattern was accomplished by introducing a well mixed and prepared solution of distilled water containing a very minute amount of liquid Ajax detergent into the annulus and transversely illuminating vertical diameter. For air in the gap, smoke was introduced. A qualitative description of the flow patterns obtained for each spherical combination studied is presented, and these descriptions are supplemented by photographs of the flow. Motion pictures of each distinctive type of flow pattern found to occur in this investigation were also obtained. For air as the working fluid, distinct steady and unsteady patterns were obtained for various diameter ratios ranging from 1.40 to 2.17 and for Grashof numbers (based on gap thickness) ranging from 7.0×10^3 to 1.2×10^6. The flow patterns at the lower Grashof numbers qualitatively agree with those obtained in previous studies. The inception of instabilities characterized by periodic interior contractions or three-dimensional spiral flow in the spherical annuli was compared to the case of horizontal cylindrical annuli. For water as working fluid, the most common basic flow pattern, the steady dog-face type, occurred in the three largest diameter ratios investigated. This kind of flow pattern has never been observed before, but it does correlate quite well with the temperature profiles obtained in the heat transfer study. A formation of tertiary flow in the weak shear layer between two secondary cells occurred for the diameter ratio of 1.78 ($L/D_i = 0.39$) at high Grashof numbers. As the Grashof number was increased above certain transition points, an unsteady dog-face type flow, or a three-dimensional spiral flow, was observed. In this study, the diameter ratio ranged from 1.09 to 2.17 and the Grashof number based on gap thickness ranged from 1.7×10^3 to 1.4×10^7. A tabular form of the experimental results for each test fluid is presented to provide categorization of the fluid-flow behavior within the available ranges of independent variables. (auth)

15137 (WCAP-7837) POST DNB HEAT TRANSFER DURING BLOWDOWN. Farman, R. F.; Cermak, J. O. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1972. 59p.

A heat transfer experiment was conducted to investigate post departure from nucleate boiling (DNB) heat transfer during transient blowdown. The tests were performed with an electrically heated test section which was operated in a heat transfer loop. Blowdown was accomplished by discharging the loop to atmosphere. The initial operating conditions prior to blowdown were: pressure of 2250 psia; mass velocity from 1,000,000 to 2,500,000 lb/hr-ft^2; inlet temperature from 480 to 560°F; and heat flux from 635,000 to 1,100,000 Btu/hr-ft^2. Blowdown conditions were: initial blowdown rate from 200 to 10,000 psi/sec and average flow decay rate from 250,000 to 1,150,000 lb/hr-ft^2 sec. The test results were compared to a correlation developed by L. S. Tong which was formulated on the basis of steady state data. This correlation has been found to be conservative with respect to the transient data obtained from this test. (auth)

15138 BOILING-CURVE MEASUREMENTS FROM A CONTROLLED HEAT-TRANSFER PROCESS. Peterson, W. C.; Zaalouk, M. G. (North Carolina State Univ., Raleigh). J. Heat Transfer; 93: No. 4, 408-12(Nov 1971).

Feedback was introduced around a boiling heat-transfer process in such a way that stable operation of the process was obtained in all boiling regions including the transition region, in which, as is well known, the process itself is unstable. This system makes it possible to obtain much new information concerning both the steady state and dynamic characteristics of boiling heat-transfer processes. Pool-boiling data which were obtained by the use of this

system are presented. Accurate measurements of heater voltage and current were obtained by a new technique involving the use of digital instruments. These data are presented in the form of plotted experimental points in the nucleate, transition, and film boiling regions. The new measurement technique is described. Values of n in equation $q/A_s = CT_d^n$ were determined for all three boiling regions, where q = Btu/hr, A_s is heater surface area, and T_d is temperature difference between heater surface and ambient liquid. The ambient liquid was distilled water maintained at saturation temperature under atmospheric pressure. (auth)

15139 ULTIMATE PERFORMANCE AND LIFETESTS OF LOW TEMPERATURE HEAT PIPES. Groll, M.; Kreeb, H.; Zimmermann, P. (Univ., Stuttgart). pp 562-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The performance capabilities of low-temperature heat pipes, usable in thermionic converters for space applications and operating at temperatures from 200 to 450°K, were calculated for three types of heat pipe design, i.e., screen heat pipes, thread artery heat pipes, and regular artery heat pipes, and for a variety of heat carriers including water, ammonia, methylchloride, acetone, methanol, ethanol, propanol, and butanol. Performance limits were measured using stainless steel wall material and water heat carrier in both screen and thread artery heat pipes. The results showed that the thread artery heat pipe is superior to the other two types and that ammonia is superior to all other heat carriers up to a temperature of 345°K. In addition, life tests were performed on brass, copper, and stainless steel heat pipes using water, methanol, ethanol, acetone, and hexane heat carriers. From these tests it was concluded that: brass is unusable due to corrosion; copper showed no corrosion with any of the carriers used; stainless steel performed well with alcohols, acetone, and hexane, but water cannot be used with stainless steel without special pretreatment due to the rapid formation of a gas buffer. (L.C.L.)

15140 DYNAMIC BEHAVIOR OF HEAT PIPES. Zimmermann, P. (Univ., Stuttgart). pp 567-70 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A theoretical analysis is presented of the dynamic behavior during startup of a heat pipe with a frozen heat carrier. A mathematical method for calculating the temperature distribution along the pipe length at fixed time intervals during the startup period is described. (L.C.L.)

15141 UNPERTURBED MULTIPLE ELLIPTICAL ORBIT RE-ENTRY OF ISOTOPIC HEATERS. Barsell, Arthur W. (Donald W. Douglas Labs., Richland, Wash.). J. Spacecraft Rockets; 8: No. 12, 1235-7(Dec 1971).

Results based on a relatively simple two-body orbital model which contains essential features but neglects second-order effects such as outer atmospheric drag and earth rotation and oblateness are presented. When checked against sparse rigorous computer solutions which include these second-order effects, the model yields accurate trajectory results with a suitably practical level of effort. Accuracy wanes with exponentially increasing orbits at shallower angles because the atmosphere above 400,000 ft is neglected and solar/lunar gravity effects become more prominent. Although a specific design was assumed, basic trends should apply to similar configurations since the ballistic coefficient is not a critical parameter. Further investigation is needed to determine the effect of solar/lunar gravity forces. (auth)

Materials Testing

Refer also to abstracts 14767 and 15355.

15142 CALCULATION OF SCATTERED GAMMA RADIATION IN NONDESTRUCTIVE TESTING. Kol'chuzhkin, A. M.; Uchaikin, V. V. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 4, 108-15(1971). (In Russian).

Methods of calculation of disturbances in a gamma radiation field caused by small-dimension inhomogeneities were examined. The theories of disturbances and of defects are explored, and separate mathematical treatments are devoted to the subjects of thin screens, collimators, statistical fluctuations, and the use of the Monte Carlo method. (K.S.W.)

15143 DETECTING MINUTE AMOUNTS OF RESIDUAL CORE MATERIAL BY MEANS OF NEUTRON RADIOGRAPHY. Wilkinson, Charles D.; Meyer, Bruce C. (to General Electric Co.). U. S. Patent 3,617,747. 2 Nov 1971. Filed 26 Sep 1968.

A method of detecting very small amounts of residual core material remaining in inaccessible internal passages in a cast metal article is disclosed. Typically, a very small amount of a material having a high neutron absorption cross section, such as gadolinium oxide, is mixed into the core material. After the metal article is cast and the core material removed, such as by dissolving the core away, a neutron radiograph of the article is prepared. Any remaining particles of the doped core material are very distinctly visible in the radiograph. This system is capable of detecting about 0.5 milligram particles. (Official Gazette)

15144 BOREAL ASSEMBLY FOR CONTROLLING THE B CONTENT OF B–Al ALLOY SAMPLES. Carre, J.-C.; Letour, C. (CEN, Fontenay-aux-Roses, France). Rev. Phys. Appl.; 6: No. 3, 267-72(Sep 1971). (In French).

Boreal is a small graphite pile containing a neutron source. It is intended for checking the boron or absorber contents of small slabs (e.g., Al–B alloy slabs). Measurements were made with 50 × 50 mm slabs using a reference to control the homogeneity, and standard samples to determine the absolute value. An accuracy of 2% was obtained with slabs containing 400×10^{-6}:1 boron. (France)

15145 PRESSURE VESSEL INSPECTION BY ACOUSTIC EMISSION. Kirby, N.; Bentley, L. C. (United Kingdom Atomic Energy Authority, Risley, Eng.). Brit. Chem. Eng. Process Technol.; 16: No. 10, 912-3(Oct 1971).

Signals produced by deformation occurring at defects in a metal are converted to electric signals by a piezo-electric transducer. These are amplified, filtered, and recorded as acoustic emission. The instrumentation used for applying the technique to pressure vessels is described. Vessels may conveniently be monitored during proof testing, inspection coverage of 100% being possible. The technique may also be applied during fabrication or in service. Comparison is made with other nondestructive testing methods. (UK)

15146 NON-DESTRUCTIVE TESTS WITHIN NUCLEAR TECHNOLOGY. Bauza, J. L. Ruiz (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 72, 298-304(Jul-Aug 1971). (In Spanish).

Safety is an important factor in nuclear technology. It necessitates the establishment of rigorous programs of quality control in fabrication and servicing procedures. Among these programs of quality control, nondestructive testing is of great importance as a method of homogeneity control in materials and components. A general sketch of the most utilized nondestructive tests is presented. The basic principles of the most used techniques (ultrasonics, radiography, and penetrating liquids) are described. The applications of these techniques to specific test problems in the fabrication of fuel elements, reactor vessels, and components are reported. (tr-auth)

15147 TRIANGULAR FINITE ELEMENT FOR PLATE BENDING ANALYSIS WITH TRANSVERSE SHEAR DEFORMATION. Kikuchi, Fumio; Ando, Yoshio (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: No. 12, 715-17(Dec 1971).

A triangular element for plate bending analysis is proposed in which higher order polynomials are used to represent the effect of transverse shear deformation without increasing the number of nodal quantities. Because of its triangular shape and the easy calculation afforded for the element stiffness matrix, the element can be applied to the analysis of moderately thick plates or slabs of arbitrary shape. (J.R.D.)

Nuclear Explosions

Refer also to abstracts 15228, 15232, 15235, 15236, 15349, and 15390.

15148 (LA–4866) PRELIMINARY LIGHTNING HAZARD STUDY. Miller, L. W. (Los Alamos Scientific Lab., N. Mex.). Jan 1972. Contract W-7405-eng-36. 8p. Dep. NTIS.

The probability of a lightning stroke to a simple but reasonable model for an underground nuclear test setup is calculated. The calculation is a rather crude approximation; however, its main point is to illustrate the more important mechanisms whereby lightning current can be introduced into the system and to indicate the steps that should be taken to do a more exact calculation. The consequences of such a lightning stroke are also calculated so far as possible. It is concluded that pulses of amplitudes in the range of a few hundred volts to 15 kilovolts can be induced across down-hole loads. The probability of a 15 kilovolt pulse is estimated to be about 2×10^{-6} per thunderstorm-day. Pulses of

amplitude less than 1.5 kilovolts are more than 100 times as probable as this and thus constitute the main effect to be expected due to thunderstorms in the vicinity of an underground weapon testing operation. (auth)

15149 (NCG-TR-37) SUMMARY OF TIME-DELAYED ROW-CHARGE CRATERING EXPERIMENTS, SITE 300, 1970. Meisinger, Richard J. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). May 1971. 19p. Dep. NTIS.

Time-delayed row-charge cratering experiments were conducted to evaluate the effect on cratering performance of time delays between successive charges in single row-charge detonations and time delays between rows in double row-charge detonations. Tests were conducted using 1- and 2-lb charges of composition C-4 explosive in sand. Maximum crater volume for the single row-charge configuration occurred with the simultaneous detonation of all charges. As time delays between successive charges were increased from 0 to 100 msec, total crater volume decreased by 36%. The total cross-sectional area of the crater from a double row-charge detonation in level terrain remained approximately constant for delay intervals from 0 to 100 msec between rows. That portion of the area between the charges of adjacent rows increased 62% as the delay interval increased from 0 to 100 msec. The total cross-sectional area and that portion of the area between the charges of adjacent rows of the crater from a double row-charge detonation on an 8-deg side slope were greater when fired with a 50-msec delay between rows as compared to simultaneous detonation. (auth)

15150 (SC-RR-710612) AIRBLAST WAVES FROM CONTAINED UNDERGROUND EXPLOSIONS. Reed, Jack W. (Sandia Labs., Albuquerque, N. Mex.). Dec 1971. 23p. Dep. NTIS.

Relatively weak shock waves are induced into the atmosphere by ground surface motion above contained underground nuclear explosives (NE) bursts. Aircraft participating in experiments occasionally have received significant jolts from these waves. Methods have been derived, combining theory and empiricism, for predicting these piston waves and establishing safe operating limits for air operations. Vertical cross-sections have been prepared showing the range of 0.1 psi (7 mb) and 0.2 psi (14 mb) overpressures for 1 kt NE bursts in hard rock at various burst depths. Distance scaling rules for other yields are derived and shown. (auth)

15151 (UCRL-51112) RESPONSE OF THE PIPE AND GROUND IN THE PACKARD NUCLEAR EFFECTS TEST. Wheeler, V. E.; Preston, R. G. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Aug 1971. Contract W-7405-eng-48. 136p. Dep. NTIS.

The experiments in Packard to measure the response of the line-of-sight (LOS) pipe and the ground to the stress wave generated by the explosion of the nuclear device resulted in three principal findings. The bolts securing the mated flanges in the LOS pipe immediately above the upper HE machine were severed, not by the stress wave generated by the nuclear explosion, but by the stress wave generated by the explosion of the HE. This allowed gas to diffuse from below into the section of pipe above the machine. If the ball valves above and the fastgate at the surface had not closed, this failure of the flange bolts would have resulted in a serious leakage of radioactive material. The discovery that the flange bolts on the LOS pipe had been severed by the HE machine, a defect to be avoided in design of LOS pipes, came as a surprise. The signals measured with velocity gages on the LOS pipe below the lower slip joint indicated that the pipe below had telescoped in two distinct steps, first prior to 35 msec and then prior to 65 msec. Reexamination of a record from a velocity gage on the Hupmobile LOS pipe below the lower slip joint indicated that similar stepwise telescoping of the pipe had occurred with that nuclear test. Records from velocity gages on other types of pipes, e.g., Pinex pipes, can be examined for possible indications of similar telescoping of pipes below the gages. A measurement in the ground 196 ft above the center of the nuclear explosion yielded a peak velocity considerably higher than had previously been measured with an explosion in alluvium. Because the validity of this measurement was not clearly established, attempts should be made to verify it in forthcoming tests. (auth)

15152 (UCRL-73473) ESTIMATION OF THE DISTRIBUTION OF TRITIATED WATER BETWEEN THE VAPOR PHASE AND MOLTEN ROCK IN THE CAVITY CREATED BY A NUCLEAR EXPLOSION, WITH SPECIAL REFERENCE TO RECENT FRENCH DATA. Bedford, R. G. (California Univ., Livermore. Lawrence Radiation Lab.). 14 Oct 1971. 8p. (CONF-711032-1). Dep. NTIS.

From French-U. S. Exchange on Peaceful Uses of Nuclear Explosives Conference; Berkeley, Calif. (26 Oct 1971).

A numerical model was developed for the distribution of tritiated water between the vapor phase and molten rock in a cavity created by a contained underground nuclear explosion. It was assumed that: only water originally contained in the rock which is melted is involved; the gas volume equals the cavity volume; equilibrium is established and fixed at the melting point of the rock; the water vapor obeys the ideal gas law at the equilibrium pressure and temperature; and the mass of rock melted and volume of cavity produced are linearly proportional to the device yield. The model is applied to data from French nuclear explosions contained in granitic formations in the Sahara Desert, and results are given for the fraction of water dissolved in solidified melt. It is recommended that post-shot analyses be made for the water and tritium contents of solidified melts in Gasbuggy and other nuclear events so that correlations can be made involving cavity volume, mass of rock melted, pot-shot water content of the glass, and tritium distribution. (L.C.L.)

15153 USE OF NUCLEAR EXPLOSIVES FOR THE PRODUCTION AND STORAGE OF HYDROCARBONS. COLLOQUIUM OF THE RESEARCH ASSOCIATION ON THE TECHNIQUES INVOLVED IN THE EXPLOITATION OF PETROLEUM. Cholet, H. (Institut Francais du Petrole, Rueil-Malmaison, France); Combarnous, M.; Sarda, J. P.; Soviche, G. Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 25: No. 11, 1303-16(Nov 1970). (In French).

The effects of contained nuclear explosions are described including seismic effects, mechanical effects, and residual radioactivity. The effect of the explosion in releasing fluids saturating the medium around the explosion area is analyzed. This analysis was effected in view of the two possible objectives of such nuclear explosions: stimulation or production of an oilfield and production of a storage cavity. The results are compared with oil prospecting data previously obtained by the U.S. and the USSR, and with certain other experimental data. The comparison demonstrates that it will only be feasible to use weak charges (1 to 10 kt) with the majority of known reservoirs. (France)

15154 GAS-RECOVERY SYSTEM. Heckman, Richard A. (to United States Atomic Energy Commission). U. S. Patent 3,627,041. 14 Dec 1971. Filed 28 Apr 1970.

A system for recovering gas from a gas-bearing rock formation that has been fractured by a nuclear explosion is described. The pipe used for collecting the gas is perforated and contains steel balls to provide internal bracing against the compressive shock of the explosion and to insure a flow path for released gas entering the pipe perforations. The pipe can be recovered intact upon exhaustion of the gas. (Official Gazette)

15155 METHOD OF PRODUCING TAR SANDS WITH LATERALLY CRATERED NUCLEAR EXPLOSIONS. Dunlap, Henry F. (to Atlantic Richfield Co.). U. S. Patent 3,627,044. 14 Dec 1971. Filed 25 Sep 1969.

Two or more nuclear explosives are detonated a predetermined distance below a tar sand in a manner such that one explosion craters laterally into a cavity formed by an earlier explosion to form a relatively thin unique zone of rubble below the tar sand. The rubble is composed of material other than tar sand. The predetermined distance below the tar sand does not exceed 250 ft or three cavity radii whichever is smaller. Fluids are injected into this rubble to assist in producing oil from the tar sands. (Official Gazette)

15156 EXTENDED RANGE OSCILLOGRAPHY. Shaffer, R. M.; Dutton, D. M. (EG and G Inc., Las Vegas, Nev.). Contract AT(29-1)-1183. Photogr. Sci. Eng.; 15: No. 4, 317-21(Jul-Aug 1971).

Nuclear device diagnostic methods used at the Nevada Test Site and Supplemental Test Sites require the photographing of oscillographic displays having wide ranges of writing speeds and consequently, exposure. As a result, a recording medium which can record a wide exposure range is needed to record these traces. Using statistical techniques, a low-contrast developer was formulated which effectively increases the useful exposure range of Kodak Tri-X Ortho film by approximately four decades. An evaluation of the film/developer combination with respect to its resolution, granularity, usefulness in oscillography, and threshold sensitivity to light filtered to simulate a P-11 phosphor is presented. (auth)

Detection Systems

Refer also to abstracts 15227 and 15356.

Civil Uses

Refer also to abstracts 15214, 15229, and 15230.

15157 (NCG-TR-36) ANALYTICAL AND GRAPHICAL METHODS FOR THE ANALYSIS OF SLOPES IN ROCK MASSES. Hendron, A. J. Jr.; Cording, E. Jr.; Aiyer, A. K. (Illinois Univ., Urbana. Dept. of Civil Engineering). Jul 1971. 162p. NTIS.

Methods for analyzing the static stability of rock slopes cut by a three dimensional network of discontinuities are given. The general use of vector analysis to solve these problems analytically is described and a method utilizing stereonets to solve these problems graphically is also given. For both the graphical and analytical methods the general analysis of slopes cut by one, two, or three sets of discontinuities is presented which can take into account the porepressures acting on the discontinuities and external forces acting on the slope. Detailed examples are given to illustrate both the graphical and vector methods of analysis. The dynamic stability of slopes is also treated. It is shown that the dynamic resistance of a three-dimensional rock slope can be calculated by either the graphic-stereonet method or the analytic vector analysis method. The dynamic resistance can then be used to estimate the movement of the slope under dynamic loading using a procedure given by Newmark (1965). A criterion is then given for determining if the calculated movement of the rock slope is acceptable or harmful. (auth)

15158 (NVO-67(Rev.1)) NUCLEAR CRATERING EXPLOSION EFFECTS FOR INTEROCEANIC CANAL FEASIBILITY STUDIES. Klement, Alfred W. Jr. (Nevada Operations Office (AEC), Las Vegas). Nov 1971. 154p. Dep. NTIS.

A discussion is presented of current knowledge of the airblast, ground motion, and radioactivity effects associated with nuclear excavation and of methods for predicting effects and for preventing damage to property and personnel. It is concluded that currently developed effects prediction techniques and concepts for the safe application of nuclear excavation are adequate for feasibility studies, but that more empirical data on higher yield explosions in a variety of geologic materials are required in order to firmly assess the safety of nuclear excavation. (L.C.L.)

15159 (PNE-RB-3) RESERVOIR REPORT. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev.). [1970]. 266p. Dep. NTIS.

In April 1970 a Project Rio Blanco feasibility study report was issued in which the prospects for nuclear stimulation of natural gas production in a portion of the Piceance Basin, Colorado were evaluated. The resource evaluation narrowed the study down to a detailed examination of the Fort Union Formation and the Upper portion of the Mesaverde Formation, designated as Mesaverde I. As recommended in the Feasibility Study, two wells, Fawn Creek Government Number 1 and Scandard Draw Number 1 were selected for recompletion and testing to obtain more detailed information on the reservoir characteristics. In addition to the testing, several logs were run in the wells. Surface studies of the sand outcrop to determine orientation and extent of sand lenses in the Mesaverde and Fort Union formations were made, and seismic surveys were run to determine the location of any geologic discontinuities in the area of interest. The well testing and recompletion histories on both wells, the evaluation of net gas sand based on the new logs, a report of the outcrop study performed during the summer of 1970, and the seismic survey report are presented. (auth)

15160 (PNE-RB-4) ENVIRONMENTAL IMPACT EVALUATION. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev.). 12 Oct 1971. 335p. Dep. NTIS.

The environmental impact statement for the Rio Blanco Event, a multiple-explosive contained nuclear explosion experiment in Colorado for studying natural gas production stimulation, is presented. Detailed information is given on: the geology, geography, hydrology, seismic activity, surface and subsurface resources, land use, cultural features, climate, and air quality of the site; the probable environmental impact of site construction, event ground motion, and radioactivity release; the alternatives to nuclear stimulation; and the environmental effects of contemplated future action. (L.C.L.)

15161 (PNE-RB-6) LLL TECHNICAL STUDIES. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev.). 2 Aug 1971. 58p. Dep. NTIS.

The Rio Blanco Event is a multiple-explosive experiment to take place in Rio Blanco Country, Colorado for the purpose of studying the use of contained nuclear explosions for the stimulation of natural gas production. Technical studies related to this event are reported and are concerned with the properties of rock in the site area, prediction of close-in explosion effects, expected gas production, production and distribution of radioactivity from the event, characteristics of the explosive canister assembly, and a proposed measurements program for determining the cavity-formation, seismic, and radiological effects of the explosion. (L.C.L.)

15162 (SC-RR-69-128) ACHIEVING FLAT SLOPES BY NONNUCLEAR DRESSING OF NUCLEAR EXPLOSIVE CRATERS. Gulick, C. W. Jr.; Vortman, L. J. (Sandia Labs., Albuquerque, N. Mex.). Oct 1969. 98p. Dep. NTIS.

If a sea-level canal is excavated through the clay shales of the Chucunaque Valley of Panama, long-term slope stability will require that the slopes be relatively flat. Nuclear excavation produces slopes which are too steep. Mechanical excavation alone is expensive. A combination of nuclear excavation, followed by a hydraulic method of dressing slopes to the angles required for stability, is examined here. Amounts of materials to be moved and costs of nuclear excavation and hydraulic slope dressing are estimated. Because no nuclear cratering experiments have been conducted in saturated clay shale, nuclear excavation row-charge crater size and shape were estimated from HE experiments; the rationale of these estimates is presented. Variations in many parameters were investigated for their effects on excavation volume and cost, including variation in depth of the navigation prism, in the bulking of ejecta, fallback, and slurry, in single versus double rows of charges, and for various crater shapes. In almost every case, cost of combined nuclear excavation and hydraulic slope dressing for a 1000-foot wide channel appears less than estimates for mechanical excavation of a 600-foot wide channel. In the best case, it is about 35% of the cost of mechanical excavation. Material volumes handled by hydraulic dressing were always more. (auth)

15163 PEACEFUL USES OF NUCLEAR EXPLOSIVES. Bhutta, Sakhi M. (Pakistan Atomic Energy Commission, Karachi). Nucleus (Karachi); 8: No. 3, 19-27(Jul-Sep 1971).

Nuclear explosives, through improvements in technology, are now regarded as a gigantic engineering tool to bring within economic reach a variety of projects previously considered impossible or uneconomic. An attempt is made to review the effects of nuclear explosions and its possible applications in industrial, mining, civil engineering sectors, etc., along with its safety and cost aspects. (auth)

Protective Structures and Equipment

Refer also to abstracts 15179, 15564, 15565, 15631, and 15666.

15164 (CONF-680614-, pp 218-25) ORBITAL GRINDER-POLISHER FOR PREPARATION OF IRRADIATED METALLOGRAPHY SPECIMENS IN HOT CELLS. Gruber, W. J.; Watts, E. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A unique orbital grinder-polisher was developed, fabricated, and installed in hot cells for preparation of irradiated metallography specimens. The compact unit occupies approximately 0.2 ft^3 of cell space. It was specifically designed to provide the capabilities of commercially available vibratory polishers without their large space requirements. Units have been in operation about two years. The design of the grinder-polisher is described, operating experience is discussed, and illustrations of results are presented. (auth)

15165 (CONF-680614-, pp 226-57) ALPHA METALLOGRAPHY LABORATORY AT OAK RIDGE NATIONAL LABORATORY. Gray, R. J.; Leslie, B. C. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

An alpha metallography glove-box line has been fabricated and installed at Oak Ridge National Laboratory. The installation is designed primarily for the handling of plutonium and its alloys, and the operating discipline is complete containment for all processes. A negative air pressure is maintained for normal operations or, if required, argon can be substituted as the internal atmosphere. The various operations in the eight glove boxes are as follows: cutting, grinding, and mounting; mechanical polishing; vacuum deposition etching; microscopic inspection; vacuum cathodic etching; chemical and electrolytic etching; replication and minor repairs of equipment; and microscopy and photomicrography. Grinding of specimens is by a lapping method; and the mechanical polishing is done on a conventional 8-in. motor-driven wheel, as well as vibratory polishing units. The inspection microscope is a modified Leitz Metallux. The metallograph is a highly modified Bausch & Lomb Research I instrument which has been sectioned so the inverted microscope is within the glove box. Illumination, visual examination, and photomicrography are coupled with the microscope through three optical relays. In addition to the eight glove boxes in a line, two glove boxes are isolated. One box is utilized for microhardness testing and mensu-

ration and the other box is equipped for photomacrography and mensuration. (auth)

15166 DEVICE FOR SEALING AN ENCLOSURE. Andre, Roger; Fradin, Jean; Rouet, Michel (to Commissariat a l'-Energie Atomique). French Patent 2,063,325. 14 Jun 1971. Filed 12 Sep 1969. (In French).

This equipment for sealing an enclosure, used to manipulate radioactive products, consists of a mobile door supported by an arm, articulated about a fixed axis and the door. Several hydraulic jacks are mounted in a framework about the aperture to be sealed; each carries a piston, parallel to the plane of the door in the closed position, and is provided with a roller. The equipment also possesses a means of controlling the assembly of hydraulic jacks and an elastic device associated with each piston, which drives the different rollers outside the framework when the hydraulic system is not used. (France)

15167 EQUIPMENT FOR DISSOLVING Na OR K OR A NaK ALLOY AFTER IRRADIATION. Mansard, Bernard (to Commissariat a l'Energie Atomique). French Patent 2,058,582. 3 May 1971. Filed 17 Sep 1969. (In French).

Equipment for dissolving Na, K, or a Na–K alloy, all of which have been irradiated, is described; they are generally contained in irradiation capsules. Na, K, or the Na–K alloy is reacted with alcohol in a neutral argon atmosphere. The reaction takes place in the presence of a liquid (kerosene) soluble in all proportions in the alcohol, the reaction being controlled by adjustment of the quantity of alcohol dissolved in the liquid. The equipment consists of two sealed sleavings, which can be joined at the ends of the irradiation capsule. The first is joined to the input fluid piping, while the second is connected to the lid of a tank with a large mouth by an intermediate spherical bush tap. This lid possesses a chimney which unites it with the tubulure of the bush tap, an inlet leading argon into the tank, and a safety valve. The tank possesses two temperature measurement devices. (France)

15168 ATMOSPHERE CONTROL SYSTEM FOR MANIPULATOR WALL PENETRATION. (to Central Research Lab. Inc.). British Patent 1,258,724. 30 Dec 1971. Priority date 3 Jul 1969, United States.

A protective sealing system is described for prevention of gas passage or passage of entrained substances through the tubular horizontal support of remote controlled master-slave manipulators in which Y movements are transmitted by tie rods and other motions are transmitted by linear movement-conveying elements. Sealing plates are positioned in the support tube transverse to its axis in such a way that tie rod movement is not hindered. The space between the seals can be gas filled or evacuated. (J.R.D.)

15169 REMOTE CONTROL MANIPULATOR WRIST JOINT. (to Central Research Lab. Inc.). British Patent 1,257,428. 15 Dec 1971. Priority date 6 Jun 1969, United States.

Improved wrist joints for the arms of remote control manipulators are described. The wrist joint is designed so that the manipulator tong is connected to the slavearm and functions in response to motions transmitted from the handle. Tong relaxation is not dependent on springs. (J.R.D.)

15170 AXIALLY DRIVABLE MEMBER AND METHOD OF MAKING SAME. (to Teleflex Inc.). British Patent 1,259,645. 5 Jan 1972. Priority date 29 May 1968, United States.

A motion-transmitting remote control assembly operable in a curved path by use of a flexible core element movably supported by a conduit is described. Use of this assembly is exemplified by a reactor temperature monitor which must be remotely moved from one location to another. The electric leads for the monitor are carried in the core element. (J.R.D.)

Safety Engineering

Refer also to abstracts 15067, 15383, and 15856.

Vacuum Engineering

Refer also to abstracts 15378 and 15741.

15171 EQUIPMENT FOR TESTING THE CREEP AND LONG-TERM STRENGTH OF METALS AT HIGH TEMPERATURES IN VACUUM OF THE ORDER OF 10^{-9} mm Hg. Evtikhin, V. A.; Zvezdin, Yu. I.; Kaprizov, V. A.; Pugaev, G. S. Ind. Lab. (USSR) (Engl. Transl.); 37: No. 2, 295-7(Feb 1971).

Translated from Zavod. Lab.; 37: No. 2, 228-30(Feb 1971).

Results of investigations are presented which show that the quality of the vacuum affects the long-term strength of niobium alloys. These materials should be tested in a vacuum of at least 1×10^{-8} mm and in an atmosphere free of oil vapors in order to obtain true strength characteristics. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

15172 (RME–4112) FLAT TOP URANIUM MINE, GRANTS, NEW MEXICO. Gabelman, John W. (Division of Raw Materials (AEC), Washington, D. C.). Oct 1970. 81p. Dep. NTIS.

The geology, stratigraphy, and mineralization of the Flat Top uranium mine in the Todilto Limestone at Grants, New Mexico are described in detail. (L.C.L.)

15173 DILATOMETRY OF TITANIUM–VANADIUM AGGLOMERATE. Utkov, V. A.; Kudinov, B. Z.; Yakovlev, V. A.; (and others). Tr. Inst. Met., Sverdlovsk; No. 22, 140-2(1970). (In Russian).

The compositional and grain size characteristics of Kachkanarskii concentrates are related to agglomeration behavior. The ore has a high Fe content and low SiO_2 content. The ore composition in % is Fe 59.9, FeO 26.0, SiO_2 5.4, TaO 2.0, V_2O_5 0.66, TiO_2 3.3, MgO 2.6, S 0.004. The grain size fractions in the concentrate are as follows (in %): +0.1 mm 23.3, +0.074 mm 15.7, –0.074 mm 61. This arises from the necessity for fine crushing of the ore. The temperature level of the sintering process is raised as a result of less development of the low-melting phases based on Ca, Si, and Fe oxides and also as a result of the presence of Ti and V oxides. The agglomerate is inclined toward crack formation as a result of internal stresses arising during cooling of the formed and hardened mass. (JPRS)

15174 RESULTS OF TECHNICAL EXPLORATIONS INTO AND THE PRODUCTION OF URANIUM RAW MATERIALS. Popovic, Branko. Nukl. Energ.; 6: No. 1, 7-12(1970-1971). (In Serbo-Croatian).

The development of explorations in the field of the technology of uranium raw materials and their use in Yugoslavia from 1948 till 1967 is presented. Results of explorations and the basic technico-economic parameters of processing of the ashes of uranium coals and uranium ores from various localities for the purpose of uranium production are given. Special activities were centered around the exploration of low-percentage uranium ores from Stara Planina, Iverak, Bukulja, Gorenja Vas, Zletovska Reka, etc. The explorations were carried out on laboratory, extended laboratory, and pilot-plant scales. (auth)

15175 REGULARITIES OF URANIUM MIGRATION IN THE OLD WEATHERING CRUST OF THE EASTERN ORENBURG TERRITORY. Vasil'eva, V. I. Geokhimiya; No. 10, 1228-35 (Oct 1971). (In Russian).

Uranium distribution in layers of the old weathering crust of rocks of different mineralogical-petrographic composition of the Eastern Orenburg territory occurred during the overall uranium evacuation (up to 30%) from rocks being weathered. However, the formation of the weathering crust was not only attended by an uranium evacuation, but its supply to the middle layer of the weathering crust was taking place at the expense of uranium supply from the overlying layer. As a result the lower and the upper layers of the weathering crust proved to be depleted in uranium up to 50%, while in the middle layers of the weathering crust a tendency towards a relative enrichment in uranium is observed (the average uranium content is here almost the same as in the parent rock). (auth)

Radioactive Effluents

Refer also to abstracts 15122, 15206, 15856, 16929, 16999, 17017, 17018, 17027, 17037, 17049, and 17076.

15176 (CONF-700848) PROCEEDINGS OF THE SEMINAR ON POLLUTION AND HUMAN ENVIRONMENT, AUGUST 26-27, 1970. (Bhabha Atomic Research Centre, Bombay (India)). 589p.

Thirty-six papers were presented at the seminar. A separate abstract was prepared for each of six papers considered to be in the scope of NSA. (J.R.D.)

For abstracts of individual papers see: 15178–15180, 15195, 15207, and 15215.

15177 (LCA/MS-RAE-2/645) PREPARATION OF A RADIOACTIVE AEROSOL. CONTROL AND INHALATION. Casse, M. (Laboratoire Central de l'Armement, Arcueil (France)). Jul 1971. 20p. (In French). Dep. NTIS (U. S. Sales Only).

A method of preparing an aerosol, simulating radioactive fallout, is described. The dispersion and grain size were studied, animal inhalation experiments being envisaged. (France)

15178 PLANNING AND MANAGEMENT OF ENVIRONMENTAL POLLUTION CONTROL AT TARAPUR NUCLEAR POWER STATION SITE. Bhat, I. S. (Bhabha Atomic Research Centre, Boisar, India). pp 76-108 of Proceedings of the Seminar on Pollution and Human Environment. Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

Measurements and investigations carried out during the period 1965 to 1969 at Tarapur to obtain base level of radioactivity and its pattern of seasonal variations, study the uptake pathways to man for radioactive contaminants in the environment; dilution availability in the environment for station discharges and find indicator samples, obtain information on the critical food material, critical group of population through demographic study, and derive acceptable contamination levels in the environment. The power reactors at Tarapur went critical in February 1969 and the station started commercial operation in January 1970. Liquid and gaseous radioactive effluents are being discharged to the environment from the station. In the marine environment the contamination above the base line due to radwaste releases from the plant have been detected up to 16 km along the shore line on both sides of station. The present levels of radioactivity in sea water, silt, and marine organisms have been assessed. Land and air radioactive contamination due to station operation have been detected. The data are compared with the pre-operational levels and permissible concentration limits in different media. These comparisons are discussed. (auth)

15179 USE OF HIGH EFFICIENCY PARTICULATE FILTERS FOR AIR POLLUTION CONTROL WITH SPECIAL REFERENCE TO NUCLEAR INDUSTRY. Khan, A. A.; Thomas, K. T. (Bhabha Atomic Research Centre, Bombay). pp 487-505 of Proceedings of the Seminar on Pollution and Human Environment. Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

A description is given of the mechanism of particulate filtration in high-efficiency filters and high efficiency filters are compared with other air cleaning devices. The design of a filter unit is explained, the understanding of which may facilitate proper use of the equipment. The basis of selecting a specific design of filter for a particular use is explained. Economic aspects of use of high efficiency particulate air filters are briefly described. Special considerations required for installation and in-situ testing of filters are discussed. Experiences in installing, testing, and other aspects of use of high efficiency filters in nuclear plants and laboratories are summarized. Possible uses of high efficiency filters in processing and handling of most hazardous materials for controlling air pollution are also briefly given. (auth)

15180 AIR SAMPLING FILTER MEDIA: THEIR CHARACTERISTICS AND USE. Khan, A. A.; Ramarathinam, K.; Thomas, K. T. (Bhabha Atomic Research Centre, Bombay). pp 506-17 of Proceedings of the Seminar on Pollution and Human Environment. Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

A brief summary on various types of commonly used filter media including their suitability and limitations for air sampling is presented. A brief review of various properties as evaluated in the laboratory and in the field is presented. Properties and uses of air sampling media developed by the Waste Treatment Division, BARC, are also given. The results of the evaluations are compared with CWS-6 and HV-70 air sampling filter media and suggestions are made regarding the possible uses of locally made filter media as a substitute for the presently imported ones. The mechanism of particulate filtration in air sampling media is briefly described. (auth)

Radioactivity Transport and Monitoring

Refer also to abstract 15124.

15181 (DOCKET-701292-1) WEST VALLEY REPROCESSING PLANT. Environmental Report, Plutonium Fuels Plant. (Nuclear Fuel Services, Inc., Rockville, Md.). 30 Jun 1971. 171p. Dep. NTIS.

An evaluation of the potential effects on the environment of the proposed Plutonium Fuels Plant to be built at the Western New York Nuclear Service Center in Cattaraugus County, New York is presented. This evaluation is submitted in accordance with USAEC regulations for an application for the Special Nuclear Materials License. (R.C.K.)

15182 (SFL-A-17) STUDIES ON ENVIRONMENTAL RADIOACTIVITY IN FINLAND, 1968–1970. Annual Report. (Institute of Radiation Physics, Helsinki (Finland)). Jun 1971. 65p. Dep. NTIS (U. S. Sales Only).

A separate abstract was prepared for each of the four sections of the report. (R.C.K.)

For abstracts of individual sections see: 15188, 15200, 15210, and 15211.

15183 LOGNORMAL DISTRIBUTION OF TRACE ELEMENTS IN THE ENVIRONMENT. Duval, Joe S. Jr.; Schwarzer, T.; Adams, J. A. S. (Rice Univ., Houston, Tex.). pp 120-31 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

The manner in which trace constituents are distributed within a given environment has long been a matter of interest. Numerous papers have been written on the subject, and many of those papers postulate that such distributions approach lognormality. For example, the frequency distribution of thorium concentrations in the Conway granite of New Hampshire was studied by Rogers and Adams and was shown to obey a lognormal distribution. A study of the ^{137}Cs body burden in Alaskan men also suggests a lognormal distribution. In most instances where a trace element is to be studied there are many different probability operators involved. It was found by computer simulation that the net result of a large number of probability operators acting in series converges toward a lognormal distribution. (auth)

Atmosphere

Refer also to abstract 16102.

15184 (AERE-R-6923) RADIOACTIVE FALLOUT IN AIR AND RAIN, Results to the Middle of 1971. Cambray, R. S.; Fisher, E. M. R.; Brooks, W. L.; Peirson, D. H. (Atomic Energy Research Establishment, Harwell (England)). Nov 1971. 53p. Dep. NTIS (U. S. Sales Only). UK 40p.

Samples of atmospheric dust and rainwater were collected from the United Kingdom and elsewhere. Results are presented of analyses of these samples for various fission productions and certain other radionuclides (^{137}Cs, ^{95}Zr, ^{140}Ba, ^{144}Ce, ^{141}Ce, ^{106}Ru, ^{103}Ru, ^{125}Sb, ^{154}Mn, ^{131}I). The concentrations of the long-lived fission products in air and rain in the United Kingdom were, in the first half of 1971, similar to those for the first half of 1970. In the summer of 1971, the Chinese explosion of 14th October, 1970 contributed about 60% of the long-lived activity, which continued at about one-tenth of the levels reached in 1963 to 64. There has been little change in the rates of deposition of ^{137}Cs and ^{90}Sr since 1966; the injection into the stratosphere of debris from Chinese nuclear explosions, in each of the years 1967 to 1970 inclusive, has counter balanced the deposition. An estimate is made of the world-wide deposition of ^{90}Sr in rain to the end of 1970; the cumulative deposition has remained substantially constant since 1966. Measurements in air in the southern hemisphere show that in mid-1971, about 60% of the long-lived activity was contributed by the French tests held in the South Pacific in 1970. Measurements of short-lived products in air and rain are given in an appendix. (UK)

15185 (MLM-1880) ENVIRONMENTAL MONITORING REPORT: JANUARY–JUNE 1971. (Mound Lab., Miamisburg, Ohio). 18 Jan 1972. Contract AT-33-1-GEN-53. 41p. Dep. NTIS.

The average concentrations of polonium-210, plutonium-238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for the first half of 1971. The average concentrations of these radioisotopes at the water sampling locations and the air sampling stations were well within the stringent standards adopted by the Atomic Energy Commission. The highest average concentrations of polonium, plutonium and tritium detected in the air sampling areas during the first half of 1971 were 39, 48 and 60% lower, respectively, than those measured during 1970. The highest average concentrations of polonium, plutonium and tritium measured at any of the water sampling locations during the first half of 1971 were 92, 75, and 89% lower, respectively, than those measured during 1970. The highest level of plutonium-238 found during the first half of 1971 in soil surface scrapings was approximately 2% of the most restrictive levels suggested by Kathren for urban areas. Soil core samples taken during the same period were considerably lower than those reported by Krey and Hardy in an independent Health and Safety Laboratory (HASL) study. (auth)

15186 (NRL-F-43) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND AND PACIFIC AREA MONITORING. Annual Summary, 1970. (National Radiation Lab., Christchurch (New Zealand)). 53p. Dep. NTIS (U. S. Sales Only).

Results from fallout monitoring activities in New Zealand during 1970 are summarized. Data are included on the total β activity in samples of atmosphere and rainwater; the content of ^{89}Sr, ^{90}Sr, and ^{210}Pb in samples of rainwater; the content of ^{137}Cs and ^{90}Sr in samples of milk; the content of ^{131}I in samples of milk and cattle thyroids; the content of ^{210}Pb, ^{90}Sr, and ^{226}Ra in samples of human bone; and the content of ^{90}Sr in samples of soil. (C.H.)

15187 (NYO-4061-4) MEASUREMENT OF AIRBORNE RADIOACTIVITY AND ITS METEOROLOGICAL APPLICATION. PART II. Annual Report, April 1, 1970–March 31, 1971. Reiter, R.; Sladkovic, R.; Poetzl, K.; Kanter, H.-J. (Fraunhofer-Gesellschaft, Garmisch-Partenkirchen (West Germany). Physikalisch-Bioklimatische Forschungsstelle). Contract AT(30-1)-4061. 193p. Dep. NTIS.

The further development and corroboration of a previously described procedure permitting the observation of air mass exchange between the stratosphere and troposphere are presented. A modified procedure of chemical analysis is described, which permits additional separation of ^{35}S besides the separation of ^{7}Be, ^{32}P, and the heavy metals of the fallout. Counting efficiency and minimum net count rate are precisely determined. Multichannel spectrometry permits identification of the radioisotopes of the fallout. New insights into the mechanism of transport inside the troposphere, between tropopause and recording station, are gained by the computation of several adjacent isentropic trajectories. The techniques employed for sampling and measuring have stood the test of continuous operation, and permit a continuous observation of stratospheric-tropospheric exchange. (auth)

15188 (SFL-A-17, pp 18-25) RADIONUCLIDES IN SURFACE AIR 1970. Blomqvist, L.; Asikainen, M. (Institute of Radiation Physics, Helsinki (Finland)).

Monthly mean concentrations for 9 gamma-emitting radionuclides and ^{90}Sr in surface air are given. The occurrence of fresh radioactive debris is also reported. The level of activity for long-lived fission products in 1970 was comparable to that of 1969, as the increase caused by continued nuclear testing in the atmosphere has roughly compensated for the decrease due to the yearly fallout. (auth)

15189 (TID-25888) SCAVENGING STUDY OF SNOW AND ICE CRYSTALS, PART I, TECHNICAL. Knutson, Earl O. (IIT Research Inst., Chicago, Ill.). Dec 1971. Contract AT-(11-1)-578. 38p. Dep. NTIS.

A review of the literature concerning the scavenging of atmospheric aerosols by snow and ice crystals shows that the role played by electrostatic charge is largely unknown. A research program is proposed which will substantially contribute to an understanding of this factor. The proposed program is an experimental study, using natural snow and a specially generated aerosol. The data to be collected are the crystal habit, size and electrostatic charge, and the number of particles captured upon exposure to an aerosol of known size and charge. These data will be examined by graphic and by statistical methods to determine the degree of correlation between electrostatic charge and scavenging efficiency. (auth)

15190 RADIOACTIVE FALLOUT AND SECULAR EFFECTS IN ATMOSPHERIC ELECTRICITY. Pierce, E. T. (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Res.; 77: No. 3, 482-7(20 Jan 1972).

Changes in the potential gradient at six observatories in Britain, Japan, and Portugal were examined for the period 1950 to 1964. The changes follow the same pattern at all six stations. The accumulation of surface radioactive fallout, following nuclear explosions, offers a plausible causative explanation for the potential gradient variations. This explanation is supported by similarities in the variations and in nuclear testing. Further confirmatory evidence is furnished by comparing British data on the potential gradient changes and on alterations in the near-surface ionization rate. Analytic development of this comparison enables the atmospheric environment at the two British observatories to be identified, respectively, as nucleus (pollution) dominated and relatively clean; this differentiation is confirmed by independent evidence and extended to the Japanese and Portuguese locations. The fallout accumulation considerably complicates studies of the electrode effect and of relationships between pollution and atmospheric electricity. (auth)

15191 ATTACHMENT OF ^{222}Rn DECAY PRODUCTS TO A NATURAL AEROSOL AS A FUNCTION OF AEROSOL PARTICLE SIZE. Van Pelt, Wesley R. New York; New York Univ. (1971). 216p. University Microfilms Order No. 71-29,696.

Thesis.

The average number of radon-222 daughter atoms attached to each natural aerosol particle was measured as a function of particle diameter for diameters from 0.02 to 0.6 μm. The attachment rate to particles in this size range is usually predicted by a hybrid mathematical model which employs both classical diffusion theory and kinetic theory. Results of investigations by Raabe, however, indicate that the radon-222 daughter attachment rate to aerosols is proportional to aerosol surface area as would be predicted by the kinetic theory model alone. Because of conflicting reports in the literature as to the appropriate form of the radon daughter attachment rate and the importance of daughter attachment in estimating the lung inhalation dose to uranium miners, this research was undertaken. Natural indoor aerosols were mixed with radon-222 gas and pulled through a 218 liter interaction chamber at a flow rate of 28 liters per minute. The radon-222 decayed successively into radium-A (Po-218), radium-B (Pb-214) and radium-C (Bi-214), and these daughters attached to the natural aerosol particles. The particle size distribution and the resultant activity size distribution of all three decay products were measured at the interaction chamber outlet with a Whitby Aerosol Analyzer. This device reproducibly charges the aerosol with negative ions and then separates the aerosol according to electrical mobility in a right circular cylindrical electrostatic precipitator. The average number of daughter atoms per aerosol particle was found to be proportional to the particle surface area. This result contradicts the widely accented hybrid attachment model and is a direct consequence of the relative numbers of daughter atoms and aerosol particles. Because aerosols were far more numerous than radon daughter atoms, any one particle rarely captured more than one daughter atom. The largest measured number of daughter atoms per aerosol particle was 0.04, with a radon concentration of 9,400 pCi/l and an aerosol concentration of 47,000 particles per cm^3. The failure of the hybrid model in describing radon daughter attachment to natural aerosols is discussed in terms of the relative numbers of daughter atoms and aerosol particles. (Diss. Abstr. Int., B)

15192 AUTOMATED ATMOSPHERIC RADON SAMPLING SYSTEM. Newstein, H.; Cohen, L. D.; Krablin, R. (Drexel Univ., Philadelphia). Atmos. Environ.; 5: No. 10, 823-31(Oct 1971).

An automated radon gas sampling system using the double filter method is described. Four such systems were installed on a 1000 ft tower in northwest Philadelphia, Pennsylvania, at elevations of 20, 200, 570, and 890 ft above ground. Simultaneous sulfur dioxide concentration measurements were made at the radon sampling elevations together with measurements of wind speed, wind direction, and temperature at elevations of 40, 100, 200, 350, 570, and 890 ft. Average radon concentrations were measured every hour, while the meteorological variables are recorded continuously, with 10 min averages calculated four times an hour. These systems have had a downtime of less than 15% since March, 1970. The radon systems are capable of monitoring radon concentrations with a sensitivity of 10^{-14} Ci l^{-1}, and an uncertainty at 10^{-13} Ci l^{-1} of 7%. The observed average radon concentration at twenty feet above the ground was 1.5×10^{-13} Ci l^{-1}, in substantial agreement with other published values. Data are presented which display the diurnal variation of radon concentration as a function of elevation. Also presented are data which show a radon concentration dependence on wind direction. (auth)

15193 LUNG CANCER AMONG POPULATIONS HAVING LUNG IRRADIATION. Archer, V. E. (National Inst. of Occupational Safety and Health, Salt Lake City). Lancet; 2: No. 7736, 1261-2(4 Dec 1971).

Doubts are expressed as to the previous estimates of the average annual radiation exposure of miners, based on measurements of radon daughter radioactivity/liter of air. Attention is drawn to a possible underestimate of reduction of radon daughter concentration brought about by improvements in ventilation. Tabulated data are presented for the occurrence of cancers in miners of zinc, silver, lead, uranium, fluorspar, hematite, hard rock, and thorium, spondylitis patients, and Japanese A bomb survivors. Miners in Sweden, U.S.A., Newfoundland, South Africa, United Kingdom, Portugal, and Denmark were included in the survey. (UK)

15194 SUMMARY OF ENVIRONMENTAL MONITORING AT AMES LABORATORY, 1962–1969. Copp, J. J. (Environmental Protection Agency, Rockville, Md.). Radiol. Health Data Rep.; 12: 119-28(Mar 1971).

The Ames Laboratory Research Reactor facility (ALRR), operated for the U. S. Atomic Energy Commission by the Iowa State University of Science and Technology, reached full power in July 1965. The preoperational and present environmental monitoring program consists of gross alpha and gross beta radioactivity determinations of air, soil, vegetation, river water, ALRR outfall, river bottom sediment, precipitation, well water, and pond water samples. The average beta radioactivity levels in air ranged from 3.86 pCi/m^3 in 1963 to 0.12 pCi/m^3 in 1967. The 1964 average level of beta radioactivity (1.26 pCi/m^3) was about one-third of the 1962 to 1963 average levels. The beta radioactivity in soil increased from 1962 to a peak of 20 pCi/g in 1964, probably due to weapons fallout, then decreased to a plateau of 13 to 15 pCi/g in 1965 through 1969. The alpha radioactivity increased from 1962 to 1964 and leveled to a plateau (1964 to 1969) of 0.7 to 1.0 pCi/g. Vegetation samples showed decreasing levels of beta radioactivity to 20 to 30 pCi/g. The alpha radioactivity in vegetation was variable with a general decrease from 1962 to 1965, leveling to 0.1 to 0.2 pCi/g in 1966 to 1968 and showing a rise to 0.91 pCi/g in 1969. Beta radioactivity concentrations in suspended solids of collected water samples ranged from the maximum of 248 pCi/liter in 1963 to a minimum of 4.70 pCi/liter in 1967. The environmental data indicate that any radiation that may have been contributed to the environment by the Ames Laboratory Research Reactor facility could not be detected. (auth)

15195 MICROMETEOROLOGICAL STUDIES FOR AIR POLLUTION CONTROL IN ATOMIC ENERGY. Shirvaikar, V. V. (Bhabha Atomic Research Centre, Bombay). pp 22-52 of Proceedings of the Seminar on Pollution and Human Environment, Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

Results of micrometeorological studies conducted at reactor sites in India are described. Applications of these results are discussed. It is noted that the data were used to calculate containment factors and hold-up periods for various exclusion distances and/or stack heights for power reactors. (J.R.D.)

Soil

Refer also to abstract 15529.

15196 DISTRIBUTION OF ^{137}Cs IN THE LITTER AND UPPER 10cm OF SOIL UNDER DIFFERENT COVER TYPES IN NORTHERN MISSISSIPPI. Ritchie, J. C.; McHenry, J. R.; Gill, A. C. (Sedimentation Lab., Oxford, Miss.). Health Phys.; 22: No. 2, 197-8(Feb 1972).

Three each of litter and soil samples were collected in 2.5 cm or 5.0 cm increments, to depths of 10 cm, from oak-hickory and pine woodland, pasture and eroded sites in northern Mississippi. Gamma ray spectra of the soil layers are presented. The concentration and redistribution of fallout ^{137}Cs appeared to be related to the vegetative cover and amount of erosion, the highest concentrations being found in the surface 2.5 cm soil layer under oak-hickory and the next highest in the surface 2.5 soil layer under pine and grass. The total ^{137}Cs concentration measured in the eroded sites was less than 4% of that measured at other sites. (UK)

15197 EXCESS ARGON IN BERYLS. Ginzburg, A. I.; Panteleev, A. I. Geokhimiya; No. 10, 1218-27(Oct 1971). (In Russian).

The content of excess radiogenic argon in beryls changes according to the geological age, the genetic type of deposits, and the physicochemical conditions of beryl formation. The specific conditions of pegmatite formation lead to a high concentration of radiogenic argon at the supercritical stage of the pegmatite process development. The behavior of argon and its accumulation in minerals may be explained by the existence of minerals, the structure of which is a peculiar trap for argon. Argon is obviously disposed in beryls in hollow channels overlapped by peculiar partitions of water and large cations of alkalies. As these channels are being filled with sodium, cesium, and water, the content of excess argon decreases in beryls. (auth)

15198 PENETRATION OF BOG PEATS AND LAKE SEDIMENTS BY TRITIUM FROM ATMOSPHERIC FALLOUT. Gorham, Eville; Hofstetter, Ronald H. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1802. Ecology; 52: No. 5, 898-902(Late Summer 1971).

Tritium in surface bog peats of the Red Lake wetland, northern Minnesota, exhibits about the same concentration as in atmospheric precipitation, which is still appreciably enriched by tritium from nuclear weapon testing. Past input pulses are not preserved in the peat profile, and the pattern of subsurface decline suggests that most of the modern precipitation rich in tritium is removed rapidly by evapotranspiration and by lateral runoff within the top 1.5 m of the 3.5-m thickness of little-decomposed Sphagnum peat at the

crest of the raised bog. However, some bomb tritium has penetrated, presumably by molecular diffusion, down to the discontinuity between the highly permeable Sphagnum peat and the underlying well-decomposed and much less permeable fen peat. In profundal lake sediments of four Minnesota lakes the influence of highly enriched precipitation from the early 1960's has likewise been largely transitory and of major significance only in sediment depths of less than 1 m, although some penetration below that depth has occurred, presumably by molecular diffusion. (auth)

Water

Refer also to abstracts 14692, 15031, and 15184.

15199 (COO-3135-1) GEOCHEMICAL STUDIES OF CONTINENTAL WATERS. Annual Report. Broecker, Wallace S.; Thurber, David L. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Oct 1971. Contract AT(30-1)-2493. 4p. Dep. NTIS.

A study of gas exchange rates in natural waters is in progress. The ^{220}Rn content of waters off Samoa was measured and will be correlated with measured data from the North Pacific area. The distribution of SO_4 in surface waters near New York City was studied. It was concluded that the source of this sulfate was SO_2 released during combustion and that the SO_4 content of surface waters decreased in a regular manner with distance away from the city center. Mechanisms of transport are still being investigated. (L.C.L.)

15200 (SFL-A-17, pp 2-17) STRONTIUM-90 AND CESIUM-137 IN WATER. Salo, Anneli (Institute of Radiation Physics, Helsinki (Finland)).

The results of ^{90}Sr and ^{137}Cs analyses of total deposition (1968 to 1970), surface water (1968 to 1969) and drinking water (up to 1968) are given. The downward trend of the annual deposition of ^{90}Sr and ^{137}Cs turned into an upward trend in 1970. In 1969 ^{90}Sr and ^{137}Cs concentrations in surface water were on average 1 pCi/l and 0.25 pCi/l respectively, the regional differences corresponding to those of the previous years. According to the results of a five-year period of analyses the removal of ^{90}Sr and ^{137}Cs from lake water by a conventional surface water purification process seemed to be very slight. (auth)

15201 NATION'S RIVERS. Wolman M. Gordon (Johns Hopkins Univ., Baltimore). Science; 174: No. 4012, 905-18(26 Nov 1971).

The problems encountered in appraising trends in water and river quality are discussed. The variables used to describe water and river quality include those associated with the water itself, i.e., transport characteristics, and those associated with the river or river site. Each of the transport characteristics such as dissolved O_2, dissolved solids, suspended sediment, pH, and temperature, which are among the common measures of water quality, is discussed as well as the radioactivity, pesticide content, and trash and debris in rivers. It is concluded that: demands on the waters of river are increasing due to population growth thereby increasing river pollution; such pollution is not an irreversible process; to affect improved river quality standard water quality measurements must be supplemented by data on land use, biological and hydrological conditions in river systems, river water flow control methods, and the input of industrial wastes; and more time and money must be spent on developing methods for measuring these variables. (L.C.L.)

15202 ^{90}Sr: DIFFUSIONAL TRANSPORT IN SEDIMENTS OF THE GREAT LAKES. Lerman, Abraham (Canada Centre for Inland Waters, Burlington, Ont.); Taniguchi, Harry. J. Geophys. Res.; 77: No. 3, 474-81(20 Jan 1972).

Penetration depth of ^{90}Sr in deep-water sediments of Lake Superior and Lake Ontario was 8 to 10 cm by 1969. A detailed picture of the ^{90}Sr-containing layer indicates that the main mechanisms of transport from lake water into sediment are diffusion of ^{90}Sr in interstitial water, and uptake of ^{90}Sr by solid phases in sediment. A diffusional transport model, with diffusion coefficient $D = 2 \times 10^{-6} - 6 \times 10^{-6}$ cm$^2 \cdot$ sec^{-1} and distribution factor $K = 120 - 440$ in favor of solids, gives ^{90}Sr concentrations in sediment comparable with observed values. Intensity of diffusional flux into sediment increases with greater uptake by solids (larger values of K). In Lake Ontario, flux into sediment has been removing ^{90}Sr from lake water at the rate of 0.2 to 0.5% per year, during the period 1954 to 1969. The slowness of flux compared with the rate of ^{90}Sr removal in lake outflow (12% per year) accounts for the small amount accumulated in sediments (4 to 6% of ^{90}Sr in lake water) and for the lack of noticeable control of concentrations in lake water by floor sediments. (auth)

15203 SOME RESULTS OF STUDY OF THE ISOTOPES OF URANIUM ^{234}U:^{238}U IN GROUND WATERS OF THE TASHKENT ARTESIAN BASIN. Spiridonov, A. I.; Sultankhodzhaev, A. N.; Surganova, N. A.; Tyminskii, V. G. Uzb. Geol. Zh.; No. 4, 82-4(1969).

The $^{234}U/^{238}U$ ratio in the mineral waters of the Tashkent basin is rather high 3.0 to 7.0, comparable to analogous uranium isotope ratios in the waters of granitic massifs. The sharp predominance of ^{234}U is evidence of "rejuvenation" of the waters of the artesian basin, probably related to inflow of fissure waters from the Paleozoic granites. This may be due to the Tashkent earthquake as well as to the intensive exploitation of the mineral waters. (Geophys. Abstr.)

15204 TRACE SUBSTANCES IN ENVIRONMENTAL HEALTH. IV. Proceedings of 4th Annual Conference Held at Columbia, Missouri, June 23-25, 1970. Hemphill, Delbert D. (ed.). Columbia, Mo.; University of Missouri (1971). 468p. $5.00. (CONF-700664).

Forty-six papers were presented in the following categories: geographical and geochemical environments; environmental pollution; ecological transport of trace substances; metabolic effects of trace substances; health effects of trace substances; and analytical methodology. A separate abstract was prepared for each of seven of the papers presented. (D.H.M.)

For abstracts of individual chapters see: 14687—14689, 15183, 15205, 15206, and 15214.

15205 CYCLING OF RADIONUCLIDES IN COLUMBIA RIVER BIOTA. Watson, D. G.; Cushing, C. E.; Coutant, C. C.; Templeton, W. L. (Battelle-Northwest, Richland, Wash.). pp 144-57 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

A study of the cycling of six radionuclides in Columbia River biota was initiated in February 1966 to define the interspecies and seasonal variations in concentrations. These data were related to major ecological factors such as light, temperature, flow, and stable element concentrations. Concentrations of radionuclides in Columbia River water are generally inversely proportional to flow levels, with highest values in winter and lowest in summer. This is related to dilution by seasonal runoff. ^{32}P, ^{65}Zn, and ^{51}Cr were the elements present in highest concentrations in the biota. Levels followed a pattern of high levels in winter and low values in summer. The relationship was particularly apparent in those organisms with high surface-to-volume ratios whose dominant mode of uptake is adsorption. The influence of the seasonal run-off overwhelmed the beneficial effects of seasonal changes in light and temperature in spring. The magnitude of seasonal changes decreased in the higher trophic levels. Concentration factors (CF) were highest for the biologically important radionuclides ^{32}P and ^{65}Zn and were highest in the primary producers. CFs decreased in higher trophic levels. (auth)

15206 RADIONUCLIDE TRANSPORT IN AN AQUATIC MODEL SYSTEM. Purushothaman, Krishnier (Univ. of Missouri, Rolla). pp 174-85 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

The radioactive wastes at very low concentrations as released by the nuclear power facilities into an aquatic system pose complex problems such as the transport of the radionuclides for further dilution downstream, simple and complex chemical changes of the radionuclide, and the concentration and subsequent release of the radioactive materials in the aquatic biota and sediments depending upon the nature and condition of the environment. A study conducted to evaluate the effects of selected clay suspensions on the transport of ^{85}Sr and ^{137}Cs in a model river is described. An instrumented flume was used to simulate a slow-moving, turbid stream which did not receive any extraneous biodegradable organic pollutant. Modified longitudinal dispersion relationships were used to describe the transport of radionuclides in the turbid stream. Data were obtained from instantaneous release of ^{85}Sr and ^{137}Cs with suspended Attapulgite and Kaolinite clays. Results showed that suspended clays in the model river system produced a significant reduction in the transport of ^{137}Cs. The transport of ^{85}Sr is not affected to a considerable degree since most of the ^{85}Sr remained in solution. (auth)

15207 AQUATIC POLLUTION CONTROL SYSTEMATICS FOR DISCHARGE OF RADIOACTIVE EFFLUENTS. Pillai, K. C. (Bhabha Atomic Research Centre, Bombay). pp 164-91 of Proceedings of the Seminar on Pollution and Human Environment. Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

The basic philosophy adopted by the Research Center for radiowaste control is "maximum containment" and "minimum release" to the environment. A systematic study of radioactive pollution control for environmental discharge of low-level liquid effluents from the Center was initiated in 1957. Detailed studies were undertaken to obtain data on dilution mechanisms in the bay, by transport and diffusion of discharged tracers, measurement of radionuclides in fish harvested from the bay, and salt produced from bay waters. On the basis of dose limits for population recommended by ICRP as related to the average consumption rate for fish and the concentration of stable elements in seawater, salt, and fish, the maximum permissible concentration of radionuclides in seawaters was evaluated. The operations were guided by those limits for waste releases into the aquatic environment. Post operational monitoring results indicate that the levels in seawater were never exceeded even in areas close to the discharge point. Radioactivity levels in silt and bottom sediments indicated higher concentrations of some radionuclides but radiation exposure from such sources were negligible. In the case of the fresh water environment of Chambal River, evaluation of acceptable limits for radiocontaminants was made utilizing the data obtained from preliminary studies at site. The limits were prescribed for the guidance of operations for control of waste release into the river. The limits will be reviewed when more data is available on the environment and its utilization. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 15439, 15518, 15523–15525, 15533, and 15544.

15208 (LA–4756) PROCEEDINGS OF ENVIRONMENTAL PLUTONIUM SYMPOSIUM HELD AT LASL, AUGUST 4–5, 1971. Fowler, Eric B.; Henderson, Richard W.; Milligan, Morris F. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. 119p. (CONF-710817). Dep. NTIS.

The purpose of this symposium was to discuss the distribution and measurement of plutonium in the environment. To this end, the subject matter was divided into three broad categories, the first dealing with how plutonium has entered the environment, the second dealing with methodology or the means by which one obtains environmental samples and analyzes them, and the third with the results obtained from such measurements and the interpretation which can be inferred from them. (auth)

15209 (ORNL-EIS-71-10) BIBLIOGRAPHY ON RADIOECOLOGY. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 225p. Dep. NTIS.

Five hundred and twenty-four references are presented to publications in field of radioecology, abstracts of which were published in Nuclear Science Abstracts, volumes 22 to 25, issue number six (1969 to March, 1971). Each entry contains bibliographic data and indexing by subject headings with modifying phases and by keywords. (C.H.)

15210 (SFL-A-17, pp 26-56) RADIOACTIVITY OF FINNISH MILK, 1968–70. Castren, O.; Paakkola, O. (Institute of Radiation Physics, Helsinki (Finland)).

The results of a country-wide survey of ^{90}Sr and ^{137}Cs in milk in Finland are given. The annual means weighted for production were: 8.9 pCi ^{90}Sr/gCa (10.7 pCi/l) and 44 pCi ^{137}Cs/gK (70 pCi/l) in 1968; 7.9 pCi ^{90}Sr/gCa (9.5 pCi/l) and 34 pCi ^{137}Cs/gK (54 pCi/l) in 1969; and 31 pCi ^{137}Cs/gK (49 pCi/l) in 1970. The method for calculating an estimate for the countrywide production-weighted mean has been improved. According to the new method the country-wide production-weighted means for ^{137}Cs in 1966 and 1967 differ from those reported earlier. The improved production-weighted means are: 85 pCi ^{137}Cs/gK (134 pCi/l) in 1966 and 58 pCi ^{137}Cs/gK (92 pCi/l) in 1967. (auth)

15211 (SFL-A-17, pp 57-63) ^{137}Cs-LEVEL IN THE CONTROL GROUP OF THE INSTITUTE OF RADIATION PHYSICS IN 1968–70. Suomela, Matti (Institute of Radiation Physics, Helsinki (Finland)).

A control group of 10 women and 16 men was measured with a whole-body counter to determine their ^{137}Cs and potassium body contents. The control group was first measured in October 1965. The results from the measurements in 1965, 1966, and 1967 were previously reported. Data for measurements in 1968 to 1971 are given. The average annual values for the Cs/K ratio in 1968, 1969, and 1970 were 72, 54, and 50 pCi/g, respectively. Before 1969, the value of the ratio decreased at a mean rate of 31% a year. In 1969 and 1970 the decrease became slower and was only about 14% a year. (auth)

15212 (SWRHL-111-r) REPORT OF THE RADIOLOGICAL CLEAN-UP OF BIKINI ATOLL. Smith, Allan E.; Moore, William E. (Western Environmental Research Lab., Las Vegas, Nev.). Jan 1972. 45p. Dep. NTIS.

The Atoll of Bikini was the subject of an intensive clean-up effort in 1969 by a joint AEC-DASA task force. The task force was responsible for rehabilitating the islands of Bikini and Eneu in preparation for the resettlement of the Bikinian people to their home islands. Objectives of the clean-up effort were: removal of all debris from the islands; determination of existing radiation levels on each island; analysis of available food items for radionuclide distribution; and clearing of vegetation from land for agricultural redevelopment. Upon completion of these objectives, the islands were turned over to the Trust Territories for the agricultural phase of the program. The radiological conditions detected before, during, and following the clean-up effort are reported. The highest exposure-rate measured on the islands of Bikini and Eneu was 120 μR/hr. The mean exposure-rate for the proposed village area on Bikini was 44 μR/hr. Integral dose calculations, involving theoretical time periods spent in various areas of the island and on the lagoon and considering shielding values from coral aggregate in the village area, were made. The external whole-body radiation dose for a person born on Bikini in 1970 and living there for 70 years was estimated to be less than 10 Rad. (auth)

15213 CRITERIA FOR THE CONTROL OF RADIOACTIVE EFFLUENTS. Morgan, K. Z.; Struxness, E. G. (Oak Ridge National Lab., Tenn.). Int. J. Environ. Stud.: 2: 111-19(1971).

The risks to the population from the U.S. nuclear energy industry are considered to be very small in comparison with other environmental risks. However, they are not zero and, on the assumption that radiation damage increases linearly with the accumulated dose, they can be expected on a statistical basis to result in a few deaths in the exposed population. Thus, the routine operation of these nuclear power plants may cause about 18 deaths/yr and the serious accidents, which may occur at a frequency of once every 50 yr, may add another six deaths/yr on the average. This is considered to be a small price to pay relative to the real, but less-well-defined, environmental risks from atmospheric pollution caused by fossil fuel power plants. Assuming the proper selection of a reactor site and all practicable precautions in the design and operation of a nuclear power reactor, adequate radiation protection for nearby populations can be assured by concentrating health physics attention on the critical radionuclides, critical pathways and critical segments of the population. (auth) (UK)

15214 MATHEMATICAL SIMULATION OF RADIONUCLIDE TRANSPORT IN TROPICAL ECOSYSTEMS. Martin, William E. (Battelle Memorial Inst., Columbus, Ohio). pp 107-19 of Trace Substances in Environmental Health. IV. /Hemphill, Delbert D. (ed.). Columbia, Mo.; Univ. of Missouri (1971).

From fourth annual conference on trace substances in environmental health; Columbia, Mo. (23 Jun 1970).

The general features are described of the methodology and procedure for estimating potential internal radiation doses due to ingestion of radioisotopes by a hypothetical population assumed to live in fallout-contaminated areas during and/or after nuclear excavation. The major steps in the procedure for assessing the radiological-safety feasibility of nuclear excavation involve the development of mathematical models to simulate physical, chemical, environmental, ecological, and physiological processes, and to describe the transport of radioisotopes in ecosystems. Using these simulation studies it was concluded that, if recommended operational procedures are carefully followed, nuclear excavation of a sea-level canal between the Atlantic and Pacific Oceans could be accomplished without exposing humans to internal radiation doses in excess of currently accepted radiological-safety guidelines. (L.C.L.)

15215 RADIOECOLOGY OF BOMBAY HARBOUR. Patel, B. (Bhabha Atomic Research Centre, Bombay). pp 294-303 of Proceedings of the Seminar on Pollution and Human Environment. Bombay; Bhabha Atomic Research Centre (1970).

From Seminar on pollution and human environment; Trombay, India (26 Aug 1970). See CONF-700848.

Data on the radioecology of Bombay Harbor are reviewed. Data on levels of radioactivity in marine matrices and biological indicators of various nuclides are summarized. Analyses of water, sediments, and biota (clams: Anadara granosa, Placenta placenta and Venerid sp., crab: Scylla serrata; and fish: Periopthalmus sp.) showed concentration of ^{137}Cs. In the harbour water, ^{137}Cs activity varied from 2 to 25 pCi/l, which was significantly higher than in coastal and oceanic waters from the Arabian Sea (0.2 to

0.4 pCi/l). Sediment samples (surface) collected from the vicinity of discharge points of waste from the Bhabha Atomic Research Center showed the maximum absorption of radioactivity (>50 pCi/gm dry sediment). The principal trend in the spread of activity was along the coast from the discharge point towards the north and south of the discharge. Clams, in general, showed higher pick-up of activity than other organisms studied (concentration factor 200 to 700). (auth)

Radiometric Techniques

Refer also to abstract 15199.

15216 Th/U RATIO AS AN AID IN PROSPECTING FOR DIAMONDS IN THE KIMBERLITIC ROCKS OF INDIA. Aswathanarayana, U. (Univ. of Saugar, India). Curr. Sci. (India); 40: No. 24, 663-4(20 Dec 1971).

A method of prospecting for diamonds in kimberlite deposits in India based on Th/U measurements is proposed. Russian experiments showed that diamondiferous kimberlites are characterized by low Th/U ratios (3 to 4) whereas kimberlites without diamonds had high Th/U ratios (15 to 20). Data on African kimberlites confirmed these findings. Aerial surveys for measuring gross radioactivity could be used to locate the kimberlite deposits, and in-situ or mine survey measurements of Th/U ratio could be used to determine the diamond content. (L.C.L.)

15217 QUANTITATIVE RELATIONS BETWEEN THE IRRADIATION DOSES AND THERMOLUMINESCENCE EFFECT IN CALCIUM FELDSPAR. Shavlo, S. G.; Stashkov, G. M.; Tsoi, A. V.; Volkov, Yu. A.; Gadaev, A. Ya. Konst. Svoistva Miner.; No. 40, 70-7(1970). (In Russian).

By the experimental study of microclines from pegmatites of the Ketmentchie deposit, the interdependence of the irradiation doses and the values of the sum of light energy stored were established. It is proved that for microclines, doses under 400,000 R result in a linear dependence and greater doses cause saturation. The existence of the linear dependence and saturation makes it possible to determine the age of microclines and its lower (minimum) boundaries acceptable for the method. (auth)

15218 DETERMINATION OF BASIC PARAMETERS INFLUENCING THE GAMMA ABSORPTION METHOD FOR THE CLASSIFICATION OF CHROMIUM ORES. Malakhov, G. M.; Sotskii, A. R.; Azaryan, A. A.; Varakuta, V. V. Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; No. 3, 13-16(1971). (In Russian).

Basic factors affecting the degree of absorption of gamma radiation are: content of Cr_2O_3, density, and sample thickness. Chromium ores with a Cr_2O_3 content of 40 to 45% absorb gamma radiation twice as much as barren rock for the same thickness. It is shown that the gamma absorption method may be used for grading ore bodies of this type. (K.S.W.)

15219 ANALYSIS OF THE AMPLITUDE, TIME, AND SPACE CHARACTERISTICS OF GAMMA-QUANTUM DISTRIBUTION IN PULSED NEUTRON-GAMMA LOGGING. Polyachenko, A. L.; Gavrina, T. E.; Tseytlin, V. G.; Shaposhnikova, T. A. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 40-56 (1969). (In Russian).

The space-time distribution of radiation-capture gamma-quanta in pulsed neutron-gamma logging is examined. In addition to amplitude, the decrement of temporal decay and the half-width of spatial distribution of intensity of the gamma field are studied as a function of delay time, sonde size, borehole diameter, and hydrogen content and absorbing properties of the formation. A theoretical-experimental algorithm is presented for quantitative determination of average life time of thermal neutrons in a formation by the pulsed neutron–gamma logging method. It reduces to measurement of the decay decrement and calculation of a correction for the given conditions of measurement. The dependence of the optimum sonde size on hydrogen content and other parameters of the problem is derived. It is shown that over a wide range of variation these optimal sonde parameters change only slightly, and can be taken as constant at about 70 cm. (Geophys. Abstr.)

15220 USE OF GAMMA–GAMMA LOGGING IN EXPLOITATION OF UNDERGROUND STORAGE OF GAS AND PETROLEUM PRODUCTS IN ROCK SALT FORMATIONS. Baembitov, F. G. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 178-89(1969). (In Russian).

For systematic monitoring of the condition of underground gas and oil storage chambers in rock salt during exploitation, it is necessary to conduct gamma–gamma logging to determine the oil (or gas) brine interface and ceiling of the chamber. Measurements with large sondes give good results in locating the interface. The data obtained make it possible to determine the shape and radius of the underground chamber. When the capacity radius is large the interface must be determined with high accuracy; for this, the pipe-coupling curve is run simultaneously with the gamma-gamma log. Results obtained during the filling of such a chamber are presented. (Geophys. Abstr.)

15221 RESULTS OF MATHEMATICAL MODELING OF GAMMA–GAMMA LOGGING FOR OIL WELL CONDITIONS. Gulin, Yu. A.; Ponyatov, G. I. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 3-20(1969). (In Russian).

Results are presented of calculations of the distribution of scattered gamma radiation in a homogeneous medium and in the system foundation-instrument-well, carried out by the Monte-Carlo method. For the case of a homogeneous medium, the dependences on density (porosity) of the rock and distance between source and registration point were studied, and the spectrums of radiation in sandstone, dolomite, and limestone formations were calculated. For the actual conditions of gamma-gamma logging, data are obtained on the number of acts of scattering of the quanta, the dependence of the readings, relative differentiation, and effect of mud crust on sonde length; on the spectrum of registered radiation, configuration of gamma-gamma curves on formation boundaries, depth of penetration of gamma-gamma logging, mechanism of influence of the mud crust, and effectiveness of collimation of source radiation and registered radiation. Optimum sonde parameters for gamma-gamma logging which will decrease the effect of distorting factors are recommended. (Geophys. Abstr.)

15222 SLOWING-DOWN AND NONSTATIONARY DIFFUSION OF NEUTRONS IN A MEDIUM WITH A CYLINDRICAL HOLE. Kantor, S. A.; Tseytlin, V. G. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 57-65(1969). (In Russian).

The space-time distribution of thermal neutrons in an infinite homogeneous medium with a cylindrical hole is examined on the axis of which there is a pulsed source of fast neutrons. Curves of the distribution of thermal neutrons in the hole and in the medium at different moments of time are obtained. It is shown that the presence of the hole does not prevent the use of known algorithm for determining the coefficient of diffusion of thermal neutrons in the medium, and leads only to a small decrease in that coefficient. Nor does the hole prevent determination of the average life time of thermal neutrons in the medium. (Geophys. Abstr.)

15223 INVESTIGATION OF THE EQUATIONS OF NEUTRON DIFFUSION BY THE GRID METHOD, AS APPLIED TO PROBLEMS OF NUCLEAR GEOPHYSICS. Denisik, S. A.; Lukhminskii, B. E.; Rezanov, R. A.; Lebedev, V. E. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 7, 20-5(1969). (In Russian).

It is proposed that the method of infinite difference approximations (grid method) be used to solve the equation of single-velocity diffusion of neutrons. A solution is given for the problem of the space-time distribution of thermal neutrons in dry silica sand, taking the spatial distribution of slowing-down obtained from age theory as the initial distribution of the thermal neutrons. The stability condition of the finite-difference equation used is derived. Results of the solution obtained by the grid method are compared with results obtained by the Monte Carlo method and with the analytical solution. To obtain the space-time distribution of neutrons in mediums with complex geometry, it is suggested that the finite difference method be used in conjunction with the Monte Carlo method. (Geophys. Abstr.)

15224 COLUMN SCANNING WITH 60 keV GAMMA RADIATION. De Swart, J. G.; Groenevelt, P. H. (Inst. for Atomic Sciences in Agriculture, Wageningen, Netherlands. State Agricultural Univ., Wageningen, Netherlands). Soil Sci.; 112: No. 6, 419-24(Dec 1971).

An automatic column scanning apparatus is discussed. Water content measurement in a 1-mm segment of a 5-cm-diameter column is performed by 60-keV ^{241}Am γ attenuation. Special attention is paid to the apparent attenuation coefficient for water present in a packed column. An experiment about redistribution of fresh and salt water in loess is reported. (auth)

Site Surveys

Refer also to abstracts 15064, 15159, 15161, 16920, 17078, and 17128.

15225 (CGS-746-118) ALEUTIAN SEISMIC PROGRAM, SEISMOLOGICAL BULLETIN, MARCH 1971. (National Oceanic and Atmospheric Administration, Rockville, Md. Environmental Research Labs.). Jan 1972. Contract AT(29-2)-746. 73p. Dep. NTIS.

Tabulated preliminary data acquired during March 1971 from an Aleutian network of seismic stations are presented in order to facilitate current studies of earthquake occurrence in the

Aleutian Islands. Each table includes information on: date; station; phase; time of arrival of phase; ground motion amplitude; period of phase; station magnitude; great circle distance to event; station-to-epicenter azimuth; phase travel time residual; and descriptive remarks. Six maps are presented covering the Aleutian Islands from the Near Islands to Unimak Island on which are plotted Aleutian earthquakes which were located during the month by the Aleutian seismic network and by a world network of seismological stations. (L.C.L.)

15226 (EUR-4710) 12th 1970 METEOROLOGICAL YEARBOOK. Bollini, G.; Gandino, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1971. 89p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR Lit. 1560,-.

After a short description of the methods for measuring and describing atmospheric phenomena, many tables and graphics for the meteorological year 1970 are reported. With the observatory's data, temperature measurements at screen No. 4, 45 meters lower, the flow of the Novellino brook and the wind data, at the 120 meter level of the meteorological tower, are added. (auth)

15227 (NVO-1163-51) INVESTIGATION OF SALMON GROUND MOTIONS AND EFFECTS. Final Report. (Beers (Roland F.), Inc., Alexandria, Va.). 1 Apr 1965. Contract AT(29-2)-1163. 19p. Dep. NTIS.

The Salmon Event was a 5 kt nuclear explosion detonated at a 2700 ft-depth within the Tatum salt dome in Mississippi. The surface ground motions within a 100 mile range were recorded at 37 stations surrounding the test site. An analysis of the measured data resulted in the following conclusions: the damage ranges for peak particle velocity and acceleration vary with azimuthal direction from the Salmon explosion. (These ranges can be reliably defined only in two azimuthal directions owing to the insufficient number of ground motion measurements. These directions are East and South. The maximum damage ranges in these directions for particle velocity (10 cm/sec damage criterion) are 4.8 and 3.4 miles, respectively. For acceleration (0.1 g criterion) in these directions it is 8.3 and 8.9 miles, respectively. The maximum estimated range of damage for particle acceleration is 9.5 miles and for velocity 6.3 miles); low frequency ground motion associated with surface waves was present at short distances from the Salmon explosion but was not measured by the recording instruments located at these distances; none of the damage immediately surrounding the Salmon site originated from ground motion generated by the Mexican earthquake; areal variation in peak amplitudes of particle motion appears to have originated at the source; there is a resemblance of correlation between complaints and areal variation of peak amplitudes of particle motion; there is a body of circumstantial evidence which suggests that damage originated from the Salmon shot, whatever mechanism was involved; the anomalous long period pulses displayed by the records recorded at Hattiesburg and Columbia did not originate at the source, and are probably associated with a local phenomenon; and there is no consistent relationship between the general soil conditions at Columbia, Hattiesburg, and the Gulf Oil Refinery—Purvis and the anomalous long period pulse observed at Columbia and Hattiesburg. (L.C.L.)

15228 (NVO-1163-229) GROUND MOTIONS RECORDED IN LAS VEGAS FROM SEVEN UNDERGROUND NUCLEAR EVENTS. West, Lewis R. (Environmental Research Corp., Las Vegas, Nev.). Nov 1971. Contract AT(29-2)-1163. 96p. Dep. NTIS.

The results of the processing of the observed ground motion recorded in Las Vegas from seven underground nuclear detonations are presented. Six of the events were located in Yucca Flat and one in Rainier Mesa, at the United States Atomic Energy Commission's Nevada Test Site. Ground motion data recorded at instrument stations deployed by the Earth Sciences Laboratory were processed and compiled by Environmental Research Corporation. Pseudo-Relative Velocity Spectra at 5% damping were derived from the velocity seismograms. (auth)

15229 (PNE-RB-5) GEOLOGY OF THE PICEANCE BASIN, REVISION NO. 1. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev.). 2 Dec 1971. 80p. Dep. NTIS.

The geology of the Piceance Basin in Colorado, site of the planned Rio Blanco Event for studying gas stimulation by underground nuclear explosions, is described. Information is included on surface geology, joints and faults, subsurface geology, and rock properties. (L.C.L.)

15230 (PNE-RB-7) HYDROLOGY OF THE PICEANCE BASIN. Project Rio Blanco. (CER Geonuclear Corp., Las Vegas, Nev.). 30 Jul 1971. 79p. Dep. NTIS.

The hydrology of the Piceance Basin in Colorado, site of the planned Rio Blanco Event for studying gas stimulation by underground nuclear explosions, is described. Information is included on surface waters, ground water in the alluvium aquifer, and the Green River ground water system. (L.C.L.)

15231 (USGS-474-100) COMPOSITE POSTSHOT FRACTURE MAP OF PAHUTE MESA, NEVADA TEST SITE. Special Studies-86. Snyder, R. P. (Geological Survey, Denver, Colo.). 1971. Contract AT(29-2)-474. 14p. Dep. NTIS.

During 1966-70, personnel of the U. S. Geological Survey mapped explosion-induced surface fractures in rocks on Pahute Mesa. Movement occurred along many previously mapped faults. Some fracturing occurred where faults had previously not been mapped. Successive movement occurred along some faults from more than one test. (auth)

15232 (USGS-474-131) GEOLOGY AND HYDROLOGY OF THE TATUM SALT DOME, LAMAR COUNTY, MISSISSIPPI. Harvey, E. J.; Chafin, R. V. (Geological Survey, Denver, Colo.). 1963. Contract AT(29-2)-474. 48p. Dep. NTIS.

The geologic structure and stratigraphy of the Tatum salt dome area are described and the hydrologic conditions of the principal aquifers are discussed in some detail. Emphasis is placed on the direction and rate of movement of water in each of five different aquifers, the deepest of which lies at a depth of 2,600 feet below land surface in the vicinity of Tatum dome. This information on movement of ground water is needed for pretest and postshot evaluation of the contamination potential associated with the testing of nuclear devices in the salt of the Tatum dome. (auth)

15233 (USGS-474-135) CHEMICAL ANALYSES OF WATER SAMPLES COLLECTED ON AMCHITKA ISLAND, ALASKA, Amchitka-29. Beetem, W. A.; Young, R. A.; Washington, C. L.; Schroder, L. J. (Geological Survey, Denver, Colo.). 1971. Contract AT(29-2)-474. 23p. Dep. NTIS.

The chemical data from the Amchitka Island study area obtained from samples collected for and analyzed by the U. S. Geological Survey between October 1965 and November 1970 are reported. Analyses of water samples from test holes are tabulated by increasing latitude and increasing depth of sampling zone. Analyses of water samples other than test holes are tabulated by increasing latitude and decreasing longitude of sampling points. The study area from which samples are reported lies within lat 51°21′ and 51°39′ N., and long 179°24′ and 178°38′ E. (auth)

15234 (USGS-474-136) GRAVITY SURVEY OF THE AMARGOSA DESERT AREA OF NEVADA AND CALIFORNIA. Healey, D. L.; Miller, C. H. (Geological Survey, Denver, Colo.). 1971. Contract AT(29-2)-474. 30p. (NTS-99). Dep. NTIS.

A gravity survey consisting of about 1,800 observations within the 2,400-square-mile area of the Amargosa Desert has provided information regarding the basin-fill geology and buried normal faults. Analysis of five two-dimensional geologic cross sections indicates that the valley fill ranges in thickness from several hundred to more than 7,000 feet. The thickest fill apparently occurs between Lathrop Wells and Death Valley Junction and also in Mount Shador basin. At two locations steep gravity gradients are interpreted to represent high-angle normal faults hidden beneath the alluvium. Near Lathrop Wells one of these inferred faults may have been the cause for the abrupt western terminus of outcropping pre-Cenozoic rocks in both the Striped and Skeleton Hills. The second inferred fault, near Death Valley Junction, may have been the cause of the southeast termination of the Funeral Mountains. The agreement between outcrops of pre-Cenozoic rocks and the gravity anomalies is very good. Exceptions do occur, however, and in these places the gravity anomalies are useful in delineating the buried geologic structure. (auth)

15235 (USGS-474-138) SEISMICITY OF THE PAHUTE MESA AREA, NEVADA TEST SITE, 8 DECEMBER 1968- 31 DECEMBER 1970. Special Studies-89. Hamilton, R. M.; Smith, B. E.; Fischer, F. G.; Papanek, P. J. (National Center for Earthquake Research, Menlo Park, Calif.). 1971. Contract AT(29-2)-474. 173p. Dep. NTIS.

The underground nuclear explosions Benham, Purse, Jorum and Handley, detonated on Pahute Mesa, initiated earthquake sequences lasting approximately 70, 10, 20 and 60 days, respectively. Earthquakes of magnitude 2.0 or larger in these sequences numbered 2012, 24, 159 and 231, respectively; earthquake magnitudes were all less than 5. The explosion Pipkin, also detonated on Pahute Mesa, had no apparent effect on seismicity. Ninety-four percent of the earthquakes with well-determined focal depths occurred shallower than 5 km, and 95% of the located earthquakes were within 14 km of ground zero of the preceding explosion. There is no evidence for explosion-stimulated earthquake activity extending outside the area of Pahute Mesa. The spatial distribution of earthquakes appears to be largely controlled by geologic structure; however, the epicenter distribution can be associated with observed fault movement only for aftershocks of Handley.

Fault-plane solutions indicate predominant dip-slip movement in the northern part of the Pahute Mesa area for aftershocks of Benham, Jorum and Handley. In the southern part, dextral strike-slip movement was found for aftershocks of Benham and Handley. The frequency-magnitude relationships are similar for earthquakes following Benham, Purse, Jorum, and Handley. (auth)

15236 (USGS-474-140) CHEMICAL ANALYSES OF IGNEOUS ROCKS FROM DRILL HOLES AND OUTCROPS, AMCHITKA ISLAND, ALASKA (INCLUDING WORKING-POINT ROCKS OF LONG SHOT, MILROW, AND CANNIKIN EVENTS). Amchitka-31. Gard, Leonard M. Jr. (comp.) (Geological Survey, Denver, Colo.). 1972. Contract AT(29-2)-474. 19p. Dep. NTIS.

Data are tabulated on the composition of 43 core samples from five exploratory drill holes, for rocks from working points of three underground nuclear explosions, and for 18 rock samples from surface outcrops on Amchitka Island, Alaska. No interpretation was made of the results. (auth)

15237 (VUF-1023) GEOHYDROLOGY OF TATUM SALT DOME AREA, LAMAR AND MARION COUNTIES, MISS. Vela Uniform Program: Project Dribble. Final Report. Taylor, R. E. (Geological Survey, [Denver, Colo.]). Aug 1971. 63p. Dep. NTIS.

Geohydrology in the Tatum salt dome area of Lamar and Marion Counties, Mississippi, has been studied since 1961 in support of the U.S. Atomic Energy Commission's safety program for the two nuclear tests, the Salmon and Sterling Events. Tatum salt dome pierced sedimentary rocks ranging from Late Jurassic to middle Tertiary in age. Overlying the salt stock is a caprock which consists, in ascending order, of anhydrite, gypsum, and calcite. The top of the salt stock is 1,220 to 1,260 ft below sea level, and the top of the calcite caprock is 650 to more than 1,500 ft below sea level. The calcite caprock contains saline water. Ten major aquifers have been identified in the sedimentary rocks of the area; nine of them contain water under artesian pressure. The Cook Mountain Limestone aquifer contains saline water throughout the area, the Vicksburg Group yields brackish water in this area, and the other aquifers (sands of Miocene age and surficial sands) contain fresh water except where they are contiguous to the dome. (auth)

Thermal Effluents

Refer also to abstracts 15201, 16924, 17017, 17018, 17027, and 17079.

15238 (ORNL-EIS-71-25) ECOLOGICAL SCIENCES DIVISION INDEX FOR ANNUAL REVIEWS 1967-1970 THERMAL POLLUTION-BIOLOGICAL EFFECTS. Coutant, Charles C. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 122p. Dep. NTIS.

This index is designed to facilitate the use of the Thermal Pollution-Biological Effects section of the Water Pollution Control Federation (WPCF) annual literature review on wastewater and water pollution control. Inclusion of a thermal effects section began with the 1967 review (published in June 1968). Indices are included for titles of articles and authors. The title index is an alphabetical key-word-in-context (KWIC) index of all words in the report titles except those designated as trivial. Authors are indexed alphabetically. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 14776 and 16824–16828.

15239 (ORNL-TM-3652) PRACTICAL COMPUTER-BASED RECTILINEAR SCANNING SYSTEM. Bell, P. R.; McClain, W. J.; Roseberry, R. T.; Ross, D. A.; East, J. K.; Moore, E. C.; Edwards, C. Lowell; Goswitz, F. A. (Oak Ridge National Lab., Tenn.). Dec 1971. Contract W-7405-eng-26. 148p. Dep. NTIS.

A computer-based rectilinear scanning system with complete data-reduction and imaging programs is described. It is capable of accessing a radioactivity scan and providing a display of the incoming data. After scan completion the data can be averaged, corrected for scattering within the patient and displayed as a finished image within two minutes. Provisions are made for storage and retrieval of the scan data on low-cost cartridge magnetic tapes. Quantitative data from any image are quickly available as a sum of an area, a histogram of the element content or as a printed array. The system is controlled by direct simple keyboard commands and has broad provision for changes and improved programs without any hardware change. The equipment can be applied to any rectilinear scanner and is practical for clinical application. A few examples of patient scans are shown. (auth)

15240 USE OF A NaI(Tl) CRYSTAL DETECTOR FOR NEUTRON CAPTURE CROSS SECTION MEASUREMENTS. Van Halem, H.; Turrian, A. D.; Caspers, L. M. (Interuniversitair Reactor Instituut, Delft, Netherlands). Nucl. Instrum. Methods; 98: No. 1, 175-7(1972).

For a NaI(Tl) crystal an electronic weighting function has been calculated with which cascade independent measurements of the absorption cross section σ_a can be made. The function appears to be approximately proportional to the energy. (auth)

General Detectors and Monitors

Refer also to abstracts 14768, 14774, 14777, 14980, 15873, 15874, 16482, and 17119.

15241 (BARC-579) EFFICIENCY OF THE 4π-NEUTRON COUNTER. Gupta, S. K.; Kerekatte, S. S. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 9p. Dep. NTIS (U. S. Sales Only).

The efficiency of the 4π geometry neutron counter at the Van de Graaff Accelerator Laboratory was determined to an accuracy of ±7%, for neutrons in the energy range of 0.03 to 1.55 MeV. The neutrons were obtained by bombarding accurately weighed natural LiF targets with protons from the accelerator. The counter consists of twelve $^{10}BF_3$ counters embedded in a cubical paraffin block having sides of 46 cm and acting as the moderator. (auth)

15242 (CEA-R-4241) ABSOLUTE LOW-LEVEL-RADIOACTIVITY MEASUREMENT BY 4π β–γ COINCIDENCE METHOD. APPLICATION TO ABSOLUTE MEASUREMENT OF GOLD DETECTORS USED FOR CALIBRATION OF A THERMAL NEUTRONS FLUX. Hilaire, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1971. 101p. (In French). Dep. NTIS (U. S. Sales Only).

The utilization of coincidence method in the special case of low level radioactivity is studied. A detailed description of the installation is given. The conditions of measurement are defined as function of the various sources of errors. The statistic exploitation of results is particularly developed. A practical application, the measurement of 10^{-3} μCi activity of ^{198}Au detectors is given as an example of the described technique. (France)

15243 (CONF-680423–, pp 261-8) SPARK DETECTORS. Hernandez I., Leoncio (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Fisica y Matematicas); Moreno y Moreno, Augusto. (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The effects of various operating parameters such as electrode separation, applied voltage, source–detector distance, filling gas composition and the energy of the ionizing particle on the performance characteristics of spark detectors are studied. (E.J.H.)

15244 (EUR-4688) PROGRESS IN PROCESSING THE CORPUSCULAR LATENT IMAGE. Prospects for Micro-Autoradiography. Rechenmann, R. V. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). 30 Mar 1971. 24p. (CONF-700705-2). Dep. NTIS (U. S. Sales Only). EUR FF 4.45.

From seventh international conference on corpuscular photography and visual solid detectors; Barcelona, Spain (7 Jul 1970).

The working hypothesis behind the whole of the information presented, is that even by strong developers not all the dispersed silver germs, forming the corpuscular latent images, are developed. Activation of these "sub-image" specks, after exposure but before development, might then result in an increase of the number of developed silver grains. Homogeneous activation of the emulsion layers was obtained by treatment with a gold solution before development in amidol or other chemical developers. (auth)

15245 (JINR-P13-6108) ON THE LIMITING ENERGY RESOLUTION OF ΔE DETECTORS FOR α PARTICLES. Zorin, G. N.; Kushniruk, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental data on the energy resolution of the silicon surface-barrier ΔE-detectors for 5 to 9 MeV α-particles have been analyzed. The disagreement between the experimental results and theoretical calculations is explained by the presence of the spread in the detector thickness. (auth)

15246 (KFK-1458) SIMPLE PULSE SHAPE DISCRIMINATOR. Bandl, R.-E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Sep 1971. 13p. (In German). Dep. NTIS (U. S. Sales Only).

A simple pulse shape discriminator was developed to separate neutron and γ-ray pulses from a fast scintillator system. The zero crossing method is employed by measuring the time difference between the fast signal from the photomultiplier anode and the zero-crossover of a doubly-differentiated pulse from a suitable dynode. The arrangement was tested using a large sensitive area photomultiplier coupled with a NE 213 liquid scintillator. The γ-ray suppression capability of the discriminator is demonstrated both with an Am-Be source and with neutron induced fission. The system is especially suited to neutron time-of-flight experiments. (auth)

15247 (ORO-2843-21) DEVELOPMENT AND APPLICATIONS OF THIN FILM DETECTOR TO HEAVY FRAGMENT dE/dX MEASUREMENTS. Progress Report, January 1, 1971–December 31, 1971. Muga, M. L. (Florida Univ., Gainesville). Contract AT(40-1)-2843. 39p. Dep. NTIS.

Further development of the thin film detector (TFD) as a dE/dx measuring device for heavy nuclei has been made. Initial attempts have been successful in formulating a calibration procedure in which a dE/dx-Energy coincident measurement is used to determine fission fragment masses. A study of the passage of accelerated ^{127}I, $^{79,81}Br$, ^{35}Cl, and ^{16}O ions through a TFD has been partially completed, and results to date confirm the possibility of using a thin film detector-solid state detector system for heavy ion mass determinations. A proposed detector system for measuring the heavy mass component of the cosmic ray flux in outer space has been described. Position sensitivity of the two photomultiplier TFD has been established, although, with impinging alpha particles, the position resolution is rather poor. A study of fission fragment (mass selected from time-of-flight data) response to a TFD indicates a peculiar pattern of charge distribution in those fission events characterized by (1) very asymmetric division and (2) low total fragment kinetic energies. A study of light particle induced reactions in which a TFD is used to distinguish reaction products (proton vs. alpha) has been initiated using the University of Florida 4 MeV Van de Graaff. (auth)

15248 (RDT-C-15-6-T(7-71)) LOGARITHMIC MEAN SQUARE VOLTAGE (MSV) INTERMEDIATE RANGE NEUTRON FLUX MONITORING SYSTEM. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 116p. LMEC.

This standard presents the requirements for the design, performance, fabrication, and testing of a Logarithmic Mean Square Voltage (MSV) Intermediate Range Neutron Flux Monitoring System covering the neutron flux range from $\sim 8 \times 10^3$ to $\sim 2 \times 10^{10}$ nv. The gamma discrimination ratio of the system shall be greater than 4.5 R/hr/nv thereby allowing the detector to operate in gamma fluxes of 2×10^6 R/hr at neutron fluxes above approximately 3×10^6 nv. The lowest measurable neutron flux of 8×10^3 nv shall be limited by the allowable alpha plus preamplifier noise signal. The system shall consist of a logarithmic mean square voltage intermediate range electronic chassis, a cabinet enclosure, an interconnecting cable assembly, a remote preamplifier assem-

bly, a fission type neutron detector assembly, and electrostatic shields for the detector-cable and preamplifier assemblies. Buffers, comparators, and bistables will be included in the system as specified by the ordering data. The equipment and services furnished shall include all of the above hardware, the operation and maintenance manuals, the quality assurance documents, the test reports, and all the labor, materials and equipment necessary to design, manufacture, test and deliver the system and documents. The equipment shall be a part of a reactor plant protection system (PPS) and shall meet all of those criteria or requirements of RDT Standards RDT F 2-2T and RDT C 16-1T as set forth in this standard. (auth)

15249 (RDT-C-15-7-T(7-71)) GAMMA COMPENSATED IONIZATION CHAMBER ASSEMBLY (FIXED ELECTRICAL COMPENSATION). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 46p. RSO.

This standard presents the requirements for the design, performance, fabrication and testing of a gamma compensated ionization chamber assembly capable of detecting a thermal equivalent neutron flux over the range of $\sim 10^4$ to $\sim 10^{11}$ nv while simultaneously exposed to incident gamma fluxes of up to $\sim 2 \times 10^6$ R/hr. The detector assembly shall consist of a gamma compensated ionization chamber designed to operate with fixed electrical compensation and removable cables or optional integral cables and an optional electrostatic shield can and cable conduit. The equipment and services furnished shall include the complete detector assembly, the test reports, the quality assurance documents and all the labor, materials, equipment and facilities necessary to design, manufacture, test and deliver the detector assembly and documents. The detector assembly shall be part of a reactor plant protection system (PPS) and shall meet all those quality criteria of RDT Standards RDT F 2-2T and RDT C 16-1T as set forth in this standard. (auth)

15250 (RDT-C-15-8-T(7-71)) DIRECT CURRENT POWER RANGE NEUTRON FLUX MONITORING SYSTEM. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 92p. LMEC.

This standard presents the requirements for the design, performance, fabrication, and testing of a Direct Current Power Range Neutron Flux Monitoring System covering the neutron flux range from $\sim 2 \times 10^7$ to $\sim 2 \times 10^{10}$ nv in the presence of gamma fluxes up to 2×10^6 R/hr. The system shall consist of a direct current power range electronic chassis, a cabinet enclosure, an interconnecting cable assembly, a gamma compensated ionization chamber or fission type neutron detector assembly, and an electrostatic shield for the detector-cable assembly. Buffers, comparators, and bistables will be included in the system as specified by the ordering data. The equipment and services furnished shall include all of the above hardware, the operation and maintenance manuals, the quality assurance documents, the test reports, and all the labor, materials and equipment necessary to design, manufacture, test and deliver the system and documents. The equipment shall be a part of a reactor plant protection system (PPS) and shall meet all of those criteria or requirements of RDT Standards RDT F 2-2T and RDT C 16-1T as set forth in this standard. (auth)

15251 (RDT-C-15-9-T(7-71)) MEAN SQUARE VOLTAGE (MSV) POWER RANGE NEUTRON FLUX MONITORING SYSTEM. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 115p. LMEC.

This standard presents the requirements for the design, performance, fabrication, and testing of a Mean Square Voltage (MSV) Power Range Neutron Flux Monitoring System covering the neutron flux range from $\sim 2 \times 10^7$ to $\sim 2 \times 10^{10}$ nv. The gamma discrimination ratio of the system shall be greater than 4.5 R/hr/nv thereby allowing the detector to operate in gamma fluxes of 2×10^6 R/hr at neutron fluxes above approximately 3×10^6 nv. The lowest measurable neutron flux of 8×10^3 nv shall be limited by the allowable alpha plus preamplifier noise signal. The system shall consist of a mean square voltage power range electronic chassis, a cabinet enclosure, an interconnecting cable assembly, a remote preamplifier assembly, a fission type neutron detector assembly, and electrostatic shields for the detector-cable and preamplifier assemblies. Buffers, comparators, and bistables will be included in the system as specified by the ordering data. The equipment and services furnished shall include all of the above hardware, the operation and maintenance manuals, the quality assurance documents, the test reports, and all the labor, materials and equipment necessary to design, manufacture, test and deliver the system and documents. The equipment shall be a part of a reactor plant protection system (PPS) and shall meet all of those criteria or requirements of RDT Standards RDT F 2-2T and RDT C 16-1T as set forth in this standard. (auth)

15252 (RDT-C-15-10-T(7-71)) LOGARITHMIC COUNT RATE SOURCE RANGE NEUTRON FLUX MONITORING SYSTEM. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 103p. LMEC.

This standard presents the requirements for the design, performance, fabrication, and testing of a Logarithmic Count Rate Source Range Neutron Flux Monitoring System covering the neutron flux range from $\sim 2 \times 10^0$ to $\sim 2 \times 10^6$ nv while the detector is in the presence of gamma fluxes up to 2×10^6 R/hr. The system shall consist of a logarithmic count rate source range electronic chassis, a cabinet enclosure, an interconnecting cable assembly, a remote preamplifier assembly, a fission type neutron detector assembly, and electrostatic shields for the detector-cable and preamplifier assemblies. Buffers, comparators, and bistables will be included in the system as specified by the ordering data. The equipment and services furnished shall include all of the above hardware, the operation and maintenance manuals, the quality assurance documents, the test reports, and all the labor, materials and equipment necessary to design, manufacture, test and deliver the system and documents. The equipment shall be a part of a reactor plant protection system (PPS) and shall meet all of those criteria or requirements of RDT Standards RDT F 2-2T and RDT C 16-1T as set forth in this standard. (auth)

15253 (RDT-F-3-39-T(8-71)) TESTING OF HIGH TEMPERATURE CABLE FOR NUCLEAR DETECTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1971. 32p. RSO.

This standard expressly relates to the methods, procedures, and reporting formats for testing of high temperature cable for nuclear detectors. For the purposes of this standard, high temperature shall mean up to 1600°F. The phrase "Cable for Nuclear Detectors" shall mean "for reactor service with nuclear detectors, such as counters, ionization chambers, self powered, and other similar devices, operated in pulse, statistical variation, or direct current modes." The end seals and connectors, where integral, shall be considered as part of the cable. As presently written this standard related only to the electrical characteristics of the cable. The standard may later be expanded to include other related testing such as radiation tolerance, electro-magnetic interference susceptibility, mechanical characteristics, insulation compaction, etc. (auth)

15254 POLARITY-CORRELATION SYSTEM FOR FAST-REACTOR NOISE STUDIES. Lehto, W. K.; Larson, J. M.; Goin, R. W.; Hutton, J. E. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Instrum. Methods; 97: No. 3, 507-14(1971).

A system consisting of a detector signal amplifier, polarity sampler and associated gating circuitry has been designed and tested in a fast reactor application to do noise studies by polarity correlation techniques. System versatility and accurate signal processing were emphasized. Noise studies and reactivity measurements, have been done with this equipment utilizing the cross correlation and low frequency coherence techniques. (auth)

15255 MEASUREMENT OF DECAY TIMES OF LOADED LIQUID SCINTILLATORS. Koike, Y. (Tokyo Metropolitan Isotope Research Center). Nucl. Instrum. Methods; 97: No. 3, 443-7(1971).

Decay times of located liquid scintillators based on 1,6-dimethylnaphthalene are determined as a function of concentration of loaded compounds. A sampling oscilloscope is used to record the pulses from loaded liquid scintillators under americium-241 excitation. Decay times of the liquid scintillators are longer than those of common loaded liquid scintillators. These facts are considered to result from effects of 1,6-dimethylnaphthalene used as solvent. (auth)

15256 DRIFTABILITY AND THE PRECIPITATION OF LITHIUM IN GERMANIUM. Mueller, R.; Northrop, D. C. (Univ. of Manchester, Eng.). Nucl. Instrum. Methods; 97: No. 3, 459-63 (1971).

Experimental results are presented for the precipitation of lithium from supersaturated solutions of lithium in germanium. The experimental procedures are closely related to the standard methods of making lithium-compensated germanium gamma-ray spectrometers, and the five germanium crystals used are of known "driftability." A strong correlation was found between "driftability" and the temperature dependence of precipitation rate. The lithium-vacancy complex and the oxygen-vacancy complex may both be important as nucleation centers for lithium precipitation. (auth)

15257 STRIPED SEMICONDUCTOR DETECTORS FOR DIGITAL POSITION ENCODING. Haase, E. L.; Fawzi, M. A.; Saylor, D. P.; Velten, E. (Univ., Karlsruhe, Ger. Kernforschungs-

zentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 97: No. 3, 465-9(1971).

Solid state detectors with digital position read-out have been developed to permit the simultaneous measurement of several angles, or the increase of solid angle without increasing the kinematic spread. The counters are large area ion-implanted detectors with a common aluminum contact and a front contact consisting of five or twelve gold strips separated by 0.2 mm. The analogue-signal is taken in common for all strips from the aluminum contact, and from each strip the position of information is picked off via a fast charge sensitive preamplifier. This information is reduced to digital form and stored in discriminator-coincidence-buffer units. At high count rates, these detectors provide immediately available position signals and they permit the elimination of errors and background arising from collimator scattering. (auth)

15258 RELATIVE EFFICIENCY OF Ge(Li) GAMMA RAY DETECTORS FROM 0.5 TO 12 MeV. Singh, B. P.; Evans, H. C. Quenn's Univ., Kingston, Ont.). Nucl. Instrum. Methods; 97: No. 3, 475-82(1971).

The double-escape peak efficiency for several Ge(Li) detectors has been measured between 1.6 and 11.6 MeV using radioactive sources and gamma-ray cascades following proton capture reactions. These measurements were made relative to the full-energy peak efficiency which was obtained between 0.5 and 3.25 MeV. The data were fitted by empirical functions and the overall accuracy of the relative efficiency was between 3% and 5% for the full-energy peak and 6% for the double-escape peak. Several examples of branching ratio measurements are presented and the relative intensity of weak gamma-ray transitions following ^{56}Co beta decay has been determined. (auth)

15259 GEOMETRY OF TRACKS IN DIELECTRIC NUCLEAR TRACK DETECTORS. Henke, R. P.; Benton, E. V. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 97: No. 3, 483-9 (1971).

Dielectric nuclear track detectors are now being utilized in a variety of research applications involving registration of heavily ionizing charged particles. Many situations call for the identification of particle charge Z, energy E, and possibly the mass M. In these cases, a detailed knowledge of the etched track geometry is necessary to make possible computation of the relevant track parameters from the measured track features. Geometry of etched particle tracks can be quite complex. Some of the most relevant aspects of track geometry are derived and discussed in considerable detail. Two basic assumptions are made: the detector is isotropic and homogeneous, and the particle ionization rate remains constant over the etched portion of the track. Track specification and measurement parameters are developed for a variety of different situations. (auth)

15260 CHARGE AND LIGHT PEAK SHIFTS IN AN X-RAY DETECTOR. Policarpo, A. J. P. L.; Alves, M. A. F.; Carvalho, M. J. T. (Univ., Coimbra). Nucl. Instrum. Methods; 97: No. 3, 491-6(1971).

A comparison is made between the peak shifts with counting rate, for the light and charge pulses from a proportional scintillation counter with a Xe–1.0% N_2 mixture, under X-ray bombardment. With ^{241}Am and ^{109}Cd sources it was found that for a suitable anode voltage no peak shift is observed for the light pulses, although the charge peak shifts (percent) are comparable with the energy resolution. When light peaks shifts are corrected for the charge of gain of the photomultiplier with counting rate, it is observed that they are only slightly smaller than those of the charge, implying that there is a compensating effect of the gas and photomultiplier gains. (auth)

15261 300 MEGACYCLE LOGIC WITH M.E.C.L. III. Risk, W. S. (Univ. of Maryland, College Park). Nucl. Instrum. Methods; 97: No. 3, 547-54(1971).

Two high speed logic circuits developed for a high energy physics experiment have easily met or surpassed the performance of the best available commercial logic at a fraction of commercial costs. A fourfold coincidence-latch circuit and an eightfold fanout circuit built with Motorola MECL III integrated circuits demonstrate that discrete component logic even at the highest attainable speeds is fast approaching obsolescence. The output rise time of the coincidence circuit is 0.8 ns with a pulse pair resolution of less than 3⅓ ns. The output rise time of the fanout is 1.0 ns with a pulse pair resolution of 4 ns. The circuits are completely dc coupled and NIM compatible. (auth)

15262 TWIN MICROSCOPE FOR CONTACT-FREE THICKNESS MEASUREMENT OF SEMICONDUCTOR DETECTORS. Schuh, R.; Kilian, K. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 97: No. 3, 603-5(1971). (In German).

A twin microscope is described which allows thickness measurements of opaque and transparent objects without touching them. The absolute accuracy is better than 1.0 μm and the relative accuracy better than 0.3 μm. From 0 to 15.5 mm can be measured in four ranges. Thickness profiles of semiconductor counters with very good resolution can be obtained. (auth)

15263 COMPUTER-CONTROLLED MICROSCOPE FOR AUTOMATIC SCANNING OF SOLID-STATE NUCLEAR TRACK RECORDERS. Cohn, Charles E.; Gold, Raymond (Argonne National Lab., Ill.). Rev. Sci. Instrum.; 43: No. 1, 12-17(Jan 1972).

An optical microscope having computer control of specimen motion in three dimensions, via stepping motors, has been developed and used for automatic scanning of solid-state nuclear track recorders. Programming for this system includes provisions for detection and area measurement of individual tracks as well as automatic adjustment of focus. (auth)

15264 ANALYSIS OF AUTOMATIC FISSION TRACK SCANNING IN SOLID-STATE NUCLEAR TRACK RECORDERS. Gold, Raymond; Cohn, Charles E. (Argonne National Lab., Ill.). Rev. Sci. Instrum.; 43: No. 1, 18-28(Jan 1972).

A computer controlled microscope has been developed for the automatic scanning of fission tracks in solid-state track recorders. Emphasis has been placed on the attainment of absolute accuracy comparable to that already demonstrated in manual track scanning. Analysis of automatic fission track data is considered in detail. It is demonstrated that track overlap or pileup can be accurately described within the framework of the paralyzable counter model. Absolute calibration of this system has been successfully carried out for Makrofol solid-state track recorders. Absolute fission rate measurements by automatic track scanning of Makrofol have been established with at least as high an accuracy as that of manual track scanning. Limitations due to effects of nonuniformity in fission track density have been estimated. Extension of these precise capabilities to mica solid-state track recorders has been attempted. In contrast with Makrofol, unresolved difficulties have been encountered in the automatic scanning of mica. (auth)

15265 IMPROVED METHOD FOR LOCATING CHARGED PARTICLE TRACKS IN THIN PLASTIC SHEETS. Geisler, Fred; Phillips, P. R. (Washington Univ., St. Louis). Rev. Sci. Instrum.; 43: No. 2, 283-4(Feb 1972).

A new electrical method is presented for locating tracks of charged particles in very thin plastic sheets. Short high voltage pulses are employed rather than the steady voltages used previously. The method is applicable to plastic sheets of large area and of thickness down to 3.5 μ. The background is low and the efficiency greater than 85%. (auth)

15266 QUANTITATIVE DETECTOR FOR NEUTRAL PARTICLES. Barnett, C. F.; Ray, J. A. (Oak Ridge National Lab., Tenn.). Rev. Sci. Instrum.; 43: No. 2, 218-24(Feb 1972).

A neutral particle detector was constructed and calibrated for H, He, and N atoms in the energy range 0.5 to 50 keV. These neutral particles were incident on a Cu or AgMg surface that emitted secondary electrons which were accelerated to 20 keV. These energetic electrons were collected by a silicon barrier detector from which the pulse height spectrum was shown to obey Poisson statistics. From the statistical distribution the detector efficiency was determined. The efficiency of the detector increases from 77% at 0.5 keV to 100% at 2 keV and remains constant at approximately 100% up to 50 keV. Measurements and results are presented for secondary electron and reflection coefficients for electrons and H incident on various surfaces. (auth)

15267 INTRODUCTION OF HEAVY AND LIGHT RADIOACTIVE NUCLEI INTO NUCLEAR EMULSIONS. Romanova, T. A. Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 158-92(1971).

In order to study nuclear reactions and elementary particles it is sometimes desirable to introduce or "load" nuclear emulsions with specific elements. A number of problems arise in this process. The article first reviews work on the introduction of U into various emulsions. Emulsions can be made sensitive to protons with energies up to 50 MeV. Uranium can be loaded into 250- or 300-μ-thick emulsions sensitive to particles at the ionization minimum. Also discussed are the desensitizing effect of uranium salts, the reducing effect of triethanolamine, and the hardening effect of uranium. The introduction of hydrogen and deuterium into emulsions sensitive to particles at the ionization minimum is considered, as well as the introduction of Li into emulsion plates. Research on dilution of NIKFI-R emulsions with gelatin is described, and a short review of the investigation methods used in physics experiments is given. (16 figures, 12 tables, 61 references) (R.W.R.)

15268 DIRECTIONAL CORRELATION SOLID ANGLE CORRECTIONS FOR FIVE-SIDED Ge(Li) DETECTORS. Singh, A.; Lynk, E. T. (Southern Univ., Baton Rouge, La.). Nucl. Instrum. Methods; 98: No. 1, 9-11(1972).

Using the collimated-beam method, finite solid angle corrections for two five-sided Ge(Li) detectors were measured. Data were taken with source-to-detector distances of 5, 7, and 10 cm for both the cylindrical and the trapezoidal detectors. The investigated detectors had volumes of 42 cm^3 and 19 cm^3, respectively. Reasonable agreement between experimental results and the calculations of Camp and Van Lehn was found. (auth)

15269 PRECISE COORDINATE CONTROL IN FISSION TRACK URANIUM MAPPING. Haines, E. L. (California Inst. of Tech., Pasadena). Nucl. Instrum. Methods; 98: No. 1, 183-4(1972).

The problem of locating minute mineral grains by fission track uranium mapping is solved by means of a congruent transformation of the track detector's coordinate system. (auth)

15270 MONITORING 14 MeV NEUTRON FLUXES BY ASSOCIATED PARTICLE COUNTING. Kuijper, P.; Spaargaren, D. (Vrije Univ., Amsterdam). Nucl. Instrum. Methods; 98: No. 1, 173-4(1972).

When the associated alpha particles are used in the monitoring of T,d-neutrons the contribution of protons in the alpha detector from the competing D(d,p)T reaction must be considered. A particle discrimination method based on the use of a scintillation detector of suitable thickness is discussed. (auth)

15271 DIGITAL COHERENT DETECTOR. Tebra, W.; Visser, C. A. (FOM-Inst. Voor Atoom- En Molecuulfysica, Amsterdam). Nucl. Instrum. Methods; 98: No. 1, 165-8(1972).

A coherent detector with a bidirectional counter for the recovery of pulselike signals from a noisy source is described. The counter, the associated logic, and the time circuits are built with integrated circuits. Discussed is the limit of the improvement of the signal to noise ratio. In an experimental version of the coherent detector a signal to noise ratio of 110 dB was achieved. (auth)

15272 $4\pi\beta-\gamma$ ANTICOINCIDENCE METHOD AND APPARATUS FOR RADIOACTIVE CONCENTRATION MEASUREMENTS OF THE RADIOACTIVE SOLUTIONS. Chylinski, A.; Pasiewicz, K.; Radoszewski, T.; Wolski, D.; Wojtowicz, S. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods; 98: No. 1, 109-17(1972).

The $4\pi\beta-\gamma$ anticoincidence method and apparatus designed for radioactive concentration measurements of radioactive solutions are described. Obtained experimental results for ^{60}Co are tabulated and also presented in a graphic form. It is also shown that the anticoincidence method used for such measurements gives more precise results than the coincidence method. Experimental results also lead to the conclusion that the method used does not require calibration which means that this method is really absolute. Mercover block diagrams and a detailed anticoincidence circuit of the instrument are discussed. (auth)

15273 HIGH RESOLUTION CHARGED PARTICLE SPECTROMETER COMBINING A LOW DISPERSION MAGNET AND Si(Li) DRIFTED DETECTORS. Bigler, R. E.; Horton, J. L.; Zaidi, S. A. A. (Univ. of Texas, Austin). Nucl. Instrum. Methods; 98: No. 1, 125-9(1972).

A new charged particle spectrometer has been developed utilizing cooled Si(Li) drifted solid state detectors and a low dispersion sector magnet. The spectrometer can be adjusted to select a predetermined region in a charged particle spectrum for analysis in a solid state detector. Particle identification is possible since a particle's energy and momentum are measured simultaneously. The energy resolution capability of a Si(Li) detector system is improved when it is used in conjunction with the sector magnet. Construction details are presented. A number of specific applications are suggested. (auth)

15274 ANALYSIS OF THE MATHEMATICAL METHODS FOR CORRECTING CONTINUOUS X-RAY SPECTRA OBTAINED BY SCINTILLATION SPECTROMETRY. Fioratti, M. Paganini; Piermattei, S. Ricci (CNEN-CSN, Casaccia, Italy). Nucl. Instrum. Methods; 98: No. 1, 131-4(1972).

An analysis is made of the analytical methods for interpreting the bremsstrahlung spectra. Owing to the nature of the response matrix, the iterative method is the most adequate to obtain correct information. (auth)

15275 INFLUENCE OF NEUTRON-INDUCED ALPHA-PARTICLES ON PULSE HEIGHT SPECTRA IN ORGANIC SCINTILLATORS USED FOR FAST NEUTRON SPECTROSCOPY. Fabian, H. U. (Univ., Kiel). Atomkernenergie; 18: No. 4, 305-10(1971).

On certain conditions one can obtain neutron spectra from the proton recoil pulse spectra induced in organic scintillators by a differentiation method. The α-particles from the nuclear reactions $^{12}C(n,\alpha)^9Be$ and $^{12}C(n,n')3\alpha$ which are also generated by neutrons with $E_n \gtrsim 8$ MeV falsify the pulse spectra and have to be eliminated. Pulse spectra induced in stilbene and NE 213 by 14.05 MeV neutrons were measured with a double coincidence technique, and the proton contribution was subtracted. The resulting pulse distribution of the α-particles is analyzed and theoretically reconstructed with a disintegration model of the ^{12}C-nucleus. The correction of measured pulse spectra for the α-particle background is demonstrated at two examples and allows one to apply the differentiation procedure even below 3.5 MeV proton energy. (auth)

15276 EFFICIENCY CALIBRATION OF SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Durrani, S. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 98: No. 2, 229-36(1972).

The track registration efficiencies of various glasses, plastics and mica for fission fragments of various average energies and for alpha particles have been calculated on the basis of a series of new experiments in which exposures were made in "2π" and other geometries. The effects of temperature and ultra-violet light on the registration efficiencies have been studied. Lastly, certain modifications in standard formulae for source-detector geometry, when applied to SSNTD, are proposed. (auth)

15277 EFFECT OF ETCHING INTERRUPTIONS ON TRACKS FORMATION IN PLASTICS. Baroni, G.; Di Liberto, S.; Romano, G.; Sgarbi, C.; Tabasso, M. C. (Univ., Rome. Istituto Nazionale de Fisica Nucleare, Rome). Nucl. Instrum. Methods; 98: No. 2, 221-7(1972).

The effect of etching interruptions on track formation has been studied in nitrocellulose plastic sheets using α-particle tracks. The "step effect" is remarkable on some parameters of the tracks while on others, as the lengthening with development time (that is the most useful in identification of high ionizing tracks) it seems to be absent. An attempt is made to interpret this effect on the basis of the known dissolution properties of polymers. (auth)

15278 SOLID-ANGLE CORRECTION FACTORS FOR COAXIAL Ge(Li) DETECTORS. Krane, K. S. (Purdue Univ., Lafayette, Ind. Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 98: No. 2, 205-10(1972).

A method for computing the finite solid-angle correction factors for coaxial Ge(Li) detectors is presented. In particular, the correction factors Q_k for odd k are discussed. The computer program employed for the calculation is presented, and the results of the calculation are compared with experimental values. (auth)

15279 POSITION SENSITIVE PROPORTIONAL DETECTOR FOR A MAGNETIC SPECTROGRAPH. Ford, J. L. C. Jr.; Stelson, P. H.; Robinson, R. L. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 98: No. 2, 199-203(1972).

A position sensitive detector has been constructed for use at the focal plane of an Enge split-pole spectrograph. The detector is a single-wire gas proportional detector of the Borkowski-Kopp type which derives the position information from the rise time of the pulses from the two ends of a high-resistance wire anode. A position resolution of 0.7 mm was obtained for the 20 cm long detector operated with the magnet. Spectra are presented which were obtained from the Coulomb excitation of transuranic elements by α-particles. (auth)

15280 LARGE HOLLOW-CORE COAXIAL Ge(Li) DETECTORS. Fowler, I. L.; Toone, R. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 98: No. 2, 193-8 (1972).

Large volume, hollow-core coaxial, germanium lithium-drift, gamma ray detectors have been fabricated from Czochralski type crystals 55 to 70 mm dia. Crystal machining was carried out prior to drifting and both conventional and "inside-out" drifts have been made. Central holes 16 to 31 mm dia. have been used and two typical detectors and cryostats are described: (1) a 75 cm^3 detector mounted in a vertical "dipstick" type cryostat with a "well" 19 mm dia. × 100 mm long in the cap, and (2) a 44 cm^3 detector mounted horizontally in a gravity-feed cryostat having a horizontal tube passing right through the core of the detector. The latter has an absolute full-energy peak efficiency for ^{137}Cs (662 keV) γ-rays of 4.5%, and for ^{60}Co (1333 keV) γ-rays of 1.3%. (auth)

15281 MEASUREMENTS OF ELECTRON DETECTION EFFICIENCIES IN SOLID STATE DETECTORS. Lupton, J. E.; Stone, E. C. (California Inst. of Tech., Pasadena). Nucl. Instrum. Methods; 98: No. 2, 189-91(1972).

Detailed laboratory measurements have been made of the elec-

tron response of solid state detectors as a function of incident electron energy, detector depletion depth, and energy-loss discriminator threshold. These response functions were determined by exposing totally-depleted silicon surface barrier detectors with depletion depths between 50 μm and 1000 μm to the beam from a magnetic β-ray spectrometer. The data were extended to 5000 μm depletion depth using the results of previously published Monte Carlo electron calculations. When the electron counting efficiency of a given detector is plotted as a function of energy-loss threshold for various incident energies, the efficiency curves are bounded by a smooth envelope which represents the upper limit to the detection efficiency. These upper limit curves, which scale in a simple way, make it possible to easily estimate the electron sensitivity of solid state detector systems. (auth)

15282 COMPARATIVE STUDY OF THE TIMING TECHNIQUES CURRENTLY EMPLOYED WITH Ge DETECTORS. Cho, Z. H.; Chase, R. L. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 98: No. 2, 335-47(1972).

The three most commonly used techniques for timing with Ge detectors, namely the leading edge timing (LET), the extrapolated leading edge timing (ELET), and amplitude and rise time-compensated (ARC) timing are compared both theoretically and under identical experimental conditions. The effects of rise time variations and discontinuous slope changes at constant energy, as well as the energy-dependent time walks, are considered for the three timing modes. Two-parameter measurements of time variance vs energy with a planar and a coaxial detector serve to illustrate the advantages and limitations of each timing mode. (auth)

15283 TIME MEASUREMENTS WITH SPARK COUNTER. Chaturvedi, S. N.; Nath, N. (Kurukshetra Univ., India). Nucl. Instrum. Methods; 98: No. 2, 373-4(1972).

A fast photomultiplier, 56 AVP tube, has been used in conjunction with Rosenblum type spark counter to study the time relationship between the visible spark and the associated electrical pulse generated in an external RC-quenching net work. It enabled the estimation of the rise time of the spark counter pulse and the transit time of the photomultiplier tube. A brief discussion on the possible utility of this counter for timing of nuclear events through coincidence study is provided. (auth)

15284 PULSE SHAPE ANALYZER FOR FAST NEUTRON-GAMMA RAY DISCRIMINATION. Brient, C. E.; Nelson, C. E.; Young, R. L. (Ohio Univ., Athens). Nucl. Instrum. Methods; 98: No. 2, 329-33(1972).

A wide-band differential amplifier has been built to extract pulse shape information from photomultiplier dynode pulses. A zero-crossing is measured at ≈90% of peak pulse amplitude from pulses produced by neutrons and gamma-rays in a liquid scintillator. Subsequent logic circuits uniquely select and sort the gamma ray pulses and neutron pulses into separate channels for identification at rates of up to 50 kHz. (auth)

15285 CLOUD CHAMBER CONTROL AND MONITORING CIRCUITRY. MacLeod, A. M. (Univ. of Glasgow). Nucl. Instrum. Methods; 98: No. 2, 309-15(1972).

A brief discussion is given of the best operating cycle for a 2 atm expansion cloud chamber in a high intensity γ-ray beam. The control circuitry is then described in some detail, including a description of a 16 channel pulse generator driven at 100 Hz and locked to mains frequency. This generator gives one pulse per cycle in each of 16 channels, the time of each pulse being selected on a plug board, and the maximum cycle length being 100 s. A monitor circuit is then described which indicates any fault in the various functions of the cloud chamber cycling, beam injection and photography. (auth)

15286 PLANAR AND COAXIAL HIGH PURITY GERMANIUM RADIATION DETECTORS. Llacer, J. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 98: No. 2, 259-68(1972).

The successful fabrication of planar (under 1 cm^3) and coaxial (up to 5.6 cm^3) high purity germanium detectors is reported. The choice of material, processing methods to avoid contamination, and surface handling to allow the operation of the detectors at sufficient bias for excellent resolution are described. Resolutions under 2 keV for 1.33 MeV gamma rays are obtained in the coaxial geometry, with a Fano factor of 0.11 for the whole device. Measurements on the character of the exposed surfaces of the detectors show p-type channels, which can lead to substantial field non-uniformities in the bulk unless sufficient care is exercised in handling so that high bias can be applied. (auth)

15287 CORRELATION BETWEEN ETCH PIT DENSITY AND PERFORMANCE IN SURFACE BARRIER NUCLEAR DETECTORS. Chisaka, H. (Tokyo Metropolitan Isotope Research Center); Masuda, M. Nucl. Instrum. Methods; 98: No. 2, 255-7(1972).

A number of surface barrier detectors was made from silicon materials with different etch pit density. The detectors made from less etch pit have shown better performance. The etch pit density is strongly correlated with the lifetime of the carrier which gives the effect on generation-recombination noise. The situation has been investigated. Good agreement has been obtained between the experiments and theory. (auth)

15288 TWO-PARTICLE COINCIDENCE MEASUREMENT OF FOUR BODY BREAK-UP. KINEMATICS, PHASE SPACE, AND THE DETECTION OF POSSIBLE RESONANCES. Furic, M.; Forster, H. H. (Univ. of Southern California, Los Angeles). Contract No. AT(04-3)-113. Nucl. Instrum. Methods; 98: No. 2, 301-7(1972).

A simple calculation is performed to study the statistical distribution of two particle coincidences in the break-up of nuclei leading to four bodies in the final state. The possibility of detecting resonances in two and three body subsystems is discussed. (auth)

15289 LIQUID SCINTILLATION COUNTING. VOLUME 1. Proceedings of a Symposium, Salford, England, September 21-22, 1970. Dyer, A. (ed.). London; Heyden and Son Ltd. (1971). 138p. (CONF-700973-(Vol.1)).

Separate abstracts were prepared for 12 of the 13 papers given at this conference. The remaining one, on ^{14}C tracer studies of enzymes and drug actions, was not in scope for NSA. (R.W.R.)

For abstracts of individual papers see: 14777, 15290–15297, 15323, 15502, and 16419.

15290 CHEMILUMINESCENCE AS A PROBLEM AND AN ANALYTICAL TOOL IN LIQUID SCINTILLATION COUNTING. Kalbhen, D. A. (Univ., Bonn). pp 1-14 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The problems in liquid scintillation counting caused by chemiluminescence are discussed, and some suggestions on how to overcome these problems in tracer experiments are given. The ingredients of 17 useful scintillator solutions are listed, and decay curves for some of them are shown. Chemiluminescence, on the other hand, can be used as an analytical tool in organic and bioorganic chemistry; assay by this technique is described. (9 figures) (R.W.R.)

15291 EMISSION SPECTRA OF LIQUID ORGANIC SCINTILLATORS. Langenscheidt, E. (Kernforschungsanlage, Juelich, Ger.). pp 23-36 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The optical luminescence spectra of some common liquid scintillation systems are studied and compared for different modes of excitation including α, β, γ, and uv. Results are presented and discussed. (W.H.K.)

15292 4π LIQUID SCINTILLATION METHOD FOR ACTIVITY MEASUREMENT OF ELECTRON CAPTURE NUCLIDES. Tada, Andrzej; Radoszewski, Tomasz (Inst. of Nuclear Research, Warsaw). pp 49-54 of Liquid Scintillation Counting. Vol. 1./Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The 4π liquid scintillator method was used for counting the electron-capture nuclides ^{51}Cr, ^{54}Mn, ^{55}Fe, ^{65}Zn, ^{88}Y, and ^{125}I. Low-energy Auger electrons and K x rays could be counted. The counting efficiencies with PBD in toluene are tabulated. Anode and discrimination characteristics are given for ^{55}Fe. (4 tables, 1 figure) (R.W.R.)

15293 OPTIMISATION TECHNIQUES FOR COMPUTER-AIDED QUENCH CORRECTION. Krichevsky, Micah I.; MacLean, Charles J. (National Institutes of Health, Bethesda, Md.). pp 55-67 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

A systems analysis approach is necessary to find the limits of the system and those factors contributing to error in order to avoid using computer programs of undue sophistication. The maximum likelihood method is used to obtain a good estimator of the disintegration rate; automatic external standard and channels ratio quench correction are treated. The propagation of error through calculations is discussed, and sources of error and the minimization of their effects are examined. (1 figure, 2 tables) (R.W.R.)

15294 PROCESSING OF LIQUID SCINTILLATION SPECTROMETER DATA USING A DESK-TOP COMPUTING SYSTEM. Williams, M. A.; Cope, G. H. (Univ. of Sheffield, Eng.). pp 69-78 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The mathematics involved in programing a small computer for the processing of quench curves is described. Comparisons are made with hand calculations. (1 figure, 2 tables) (R.W.R.)

15295 COMPARISON OF COMPUTER-INPUT METHODS USED TO PROCESS LIQUID SCINTILLATION COUNTING DATA. Glass, D. S.; Woods, T. L. (ICI Ltd., Billingham, Eng.). pp 79-95 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The automatic calibration and quench correction procedures used in conjunction with the two liquid scintillation spectrometers with automatic external standards are described. The data processing methods and equipment used to exploit the above-mentioned procedures are discussed. (10 figures, 10 tables) (R.W.R.)

15296 NEW GELIFYING AGENT IN LIQUID SCINTILLATION COUNTING. Benakis, A. (Univ., Geneva). pp 97-104 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

Incorporation of a gelifying agent into the liquid scintillant can be used to prevent settling. The gel scintillator "Poly-Gel-B" is described; it consists of polyolefine resins which are the result of the polymerization of ethylene, propylene, butylene, and similar products as well as of the co-polymerization of two or more of these olefines with low molecular weight. The counting efficiency of Poly-Gel-B under various conditions is described. (7 figures) (R.W.R.)

15297 CRITICAL REMARKS ABOUT CURRENT TRENDS IN LIQUID SCINTILLATION COUNTING. Kalbhen, D. A. (Univ., Bonn). pp 127-9 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

Tracer samples, especially those of biological origin, have many different physico-chemical properties and need special methods of sample preparation. The principal factors which influence counting conditions and efficiency are listed. A call is issued for the elaboration of standardized sample preparation methods and instruments. (R.W.R.)

Radiation Dosimeters

Refer also to abstracts 14930 and 14969.

15298 (EGG-1183-2256) ENERGY SENSITIVITY OF DOPED POLY(HALO)STYRENE DOSIMETER FILMS. Franks, L. A. (EG and G, Inc., Goleta, Calif.). Sep 1970. 11p. Dep. NTIS.

For Sandia Corp., Albuquerque, N. Mex.

Energy sensitivity studies have been made on selected formulations of doped poly(halo)styrene dosimeter films. Measurements made at 8.7 keV and 1.25 MeV on Cl-25 (a formulation containing 25% chlorine and doped with 4% malachite green methoxide) show a relative sensitivity [S(8.7 keV)/S(1.25 MeV)] of 0.99 ± 0.11 for the 4300 Å band and 1.08 ± 0.09 for the 6300 Å band. Measurements made on Cl-5 (5% chlorine, 3% doping) at 8.7 keV and 1.25 MeV show a relative sensitivity of 1.02 ± 0.09 for 6300 Å. At 4.7 keV and 1.25 MeV, the relative sensitivity for this material was found to be 0.89 ± 0.11 for 4300 Å and 0.99 ± 0.10 for 6300 Å. These values indicate that the relative sensitivity is independent of energy for both formulations at the energies investigated. (auth)

15299 (IEA-233) PRE- AND POST-ANNEALING PROPERTIES OF LOW TEMPERATURE GLOW PEAKS 2 AND 3 IN LiF:Mg. Watanabe, Shigueo (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1971. 24p. Dep. NTIS (U. S. Sales Only).

Properties of the low temperature glow peaks 2 and 3 in LiF:Mg were investigated after removing the main peaks, 4 and 5, by annealing at 400°C for 1 hour followed by 175°C for 9 to 17 hours. EG & G LiF mini-dosimeters were used. A definite supralinearity was observed for both peaks beginning between 500 and 1,000 rad of ^{137}Cs γ-ray, with peak 3 presenting a slightly more pronounced supralinearity. S/S_0 values, where S is the sensitized TL (thermoluminescence) value and S_0 is the unsensitized one for a same exposure, were also measured after post-annealing at 280°C for one-half and one hour, or at 175°C for one hour, in each case after a sensitizing irradiation. S/S_0 and S depend upon both the temperature and duration of the post-annealing. Also, the main peak number 5, first removed by pre-annealing at 175°C, is restored with sensitizing irradiation and 280°C annealing. The height of this restored peak is a function of the initial sensitizing dose. Thermoluminescence properties of ^{7}LiF mini-dosimeters that were annealed repeatedly at 400°C for one hour, 175°C for 10 hours, and 280°C for 10 hours, and sometimes irradiated to 100 rad and read in between annealings, were also investigated. The shape and the height of glow peaks depend on the last annealing temperature. The dependence of the TL response on the pre-annealing temperature for a fixed annealing time of 10 hours was also investigated. Mini-dosimeters irradiated to high dose, read, and then annealed at 80°C for ½ hr to 3 hr present a large increase in their sensitivity. A similar result was obtained with annealing at 175°C for 1 hour followed by 80°C for 1 hour, instead of 80°C annealing only. (auth)

15300 (KFK-1462) SOME RESULTS FROM THE FIRST IAEA COMPARISON OF NEUTRON ACCIDENT DOSIMETRY SYSTEMS IN VALDUC, FRANCE, JUNE 1970. Piesch, E. (Kernforschungszentrum, Karlsruhe (West Germany)). Sep 1971. 33p. (In German). Dep. NTIS (U. S. Sales Only).

The results obtained during an international intercomparison of nuclear accident dosimetry systems with the personnel dosimeter used in the Karlsruhe Nuclear Research Center are given. Free air and phantom irradiations were performed with mixed neutron and gamma radiation of the CRAC criticality facility in Valduc. The neutron dose was measured by activation of the phosphate glass gamma dosimeter and by means of conventional activation detectors. Additional detectors were a polycarbonate foil which serves as a nuclear track detector for the detection of fast neutrons via C,O recoils and an arsenic glass for the detection of thermal and intermediate neutrons. The surface absorbed dose received by the man phantom was 348 rad due to heavy recoil particles and 384 rad due to gamma radiation. Behind a concrete shielding of 20 cm thickness the doses were 159 rad and 245 rad respectively. The comparison of the results of all participants shows that the majority of the results are found with a deviation of better than ±25% from the mean values. (auth)

15301 (KFK-1484) ENERGY DEPENDENCE OF SEVERAL COMMON DOSE RATE METERS AND DOSIMETERS FOR RADIATION PROTECTION. Burgkhardt, B.; Piesch, E. (Kernforschungszentrum, Karlsruhe (West Germany)). Sep 1971. 88p. (In German). Dep. NTIS (U. S. Sales Only).

The photon energy response of 60 common dose rate meters and dosimeters are presented, which were tested in the last years at the Karlsruhe Nuclear Research Center. The calibrations were performed with heavily filtered x-ray bremsstrahlung in the range 10 to 300 keV and with the nuclides ^{137}Cs (660 keV) and ^{60}Co (1.2 MeV). To determine the energy response, the detector reading was referred to the exposure by means of a standard detector, the reading of which was calibrated by the Physikalisch-Technische Bundesanstalt, Braunschweig. Besides the photon energy response curves a description is given of the calibration conditions of the standard detector, of the homogeneity of the filtered x-rays, and of the comparison measurement used. (auth)

15302 SENSITIVE CALORIMETRIC SET FOR X AND GAMMA BEAM CHARACTERISTICS MEASUREMENTS. Kovarik, Jiri; Kovar, Zdenek (Inst. of Nuclear Research, Prague). Jad. Energ.; 17: No. 12, 415-18(Dec 1971). (In Czech).

The modified calorimetric set used for the measurements of X and γ beam characteristics is described. The stability of the thermostating oil bath was improved, and the equipment for automatic and continual recording of followed and measured data was developed. Owing to these refinements it is now possible to measure γ beam intensities down 10 μWcm^{-2} with the relative error not more than 1.5%. The improvement of the sensitivity of the calorimetric set was verified by the measurement of the standard ^{60}Co-beam with the exposure rate of the order of $Rmin^{-1}$. (auth)

15303 APPARATUS AUTOMATICALLY PREPARING PHOTOGRAPHIC DOSIMETERS FOR DEVELOPMENT. Duport, Philippe; Eschbach, Jean; Marchal, Paul (to Commissariat a l'Energie Atomique). French Patent 2,061,551. 25 Jun 1971. Filed 12 Jun 1969. (In French).

An apparatus, which automatically prepares personnel dosimetry film badges for development, is described. These film badges consist of a base coated with an emulsion that is sensitive to nuclear radiations. They are contained within a protective envelope in a casing. The device consists of a reception stage which receives a loader full of badges, and an equal step advance mechanism which separates the different receiving spaces of the loader. A to-and-fro movement enables the envelopes to be successively

extracted from their casings. They are then placed on a trimming device. A special device separates each film from its envelope and places it in a film development folder. (France)

15304 RADIATION-INDUCED INCREASE OF THERMOLUMINESCENCE SENSITIVITY OF THE DOSIMETRY PHOSPHOR LiF(TLD-100). Zimmerman, J. (Oxford Univ.). J. Phys., C (London); 4: No. 18, 3277-91(31 Dec 1971).

Thermoluminescence (TL) and optical absorption measurements on LiF(TLD-100) show that the radiation-induced increase of TL sensitivity of this phosphor occurs in the luminescence process. New data are presented on thermally stimulated exoelectron emission (TSEE), photoluminescence (PL), and radioluminescence (RL). The TSEE results confirm that some of the TL traps in LiF(TLD-100) capture electrons. The PL behavior suggests that the increased TL sensitivity does not arise from an increase in the number of luminescence centers which participate in the TL process, and that the most likely cause of the increased TL sensitivity is the removal of competitors with the luminescence centers. The RL data indicate that the TL traps are localized near the luminescence centers, especially those centers from which there is increased photon emission. (auth)

15305 COMMENTS ON SUPRALINEARITY AND SENSITIZATION OF THE THERMOLUMINESCENT PHOSPHOR LITHIUM FLUORIDE. Townsend, P. D. J. Phys., D (London); 4: No. 12, L59-60(Dec 1971).

A new interpretation has been made of the results of Hwang (J. Phys. D., 4: 598(1971)) on thermoluminescence in TLD-100. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 14680 and 15289.

15306 (BMBW-FBK-71-16) DRIFTED RADIATION DETECTORS FOR GAMMA SPECTROSCOPY. Glasow, P.; Roth, S. (Siemens A. G., Erlangen (West Germany). Forschungslaboratorien). Oct 1971. 114p. (In German). Dep. NTIS (U. S. Sales Only).

Procedures to manufacture large volume Li-drifted germanium detectors have been developed. An ambilateral drift method for planar electrode configuration and a radial drift procedure are described. From considerations of drift efficiency it is possible to select that drift procedure which is most adequate for a given detector geometry. The drift behavior of germanium crystals grown by different methods has been studied. Energy resolution and counting efficiency of large volume detectors have been investigated. These detectors were also studied by scanning with a collimated gamma beam to investigate local anomalies in detector performance. In addition, the usability of III-V-compounds for gamma spectroscopy is discussed. Detectors from InSb have been made. Pair creation energy and breakdown voltage were measured at 78°K. From the measured values theoretical limits on energy resolution, time resolution, and counting efficiency are calculated. (auth)

15307 (CEA-R-4184) DEVELOPMENT OF A TIME-VARYING FILTER. Moroni, Max (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Jul 1971. 59p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Faculte des Sciences, Univ. of Nice, France.

A time varying filter is used in a gamma spectrometry system to obtain a good S/N ratio at high counting rates. The filter consists of a parallel CR circuit, a gradually opening linear gate, and a fast reset integrator. Theoretical considerations on the effect of different parameters, circuits, and measurements on the S/N ratio are presented. (France)

15308 (CEA-R-4226) NEUTRON ACTIVATION SPECTROMETER WITH SNAC PRINCIPLE: DESCRIPTION AND UTILIZATION. Bricka, Michel; Nguyen Van Dat; Portheos, Louis (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Nov 1971. 105p. (In French). Dep. NTIS (U. S. Sales Only).

The possibilities and limits of neutron spectrometry with activation detectors are reviewed. The method of model spectra is presented; this consists of representing the unknown spectra $\varphi(E)$ by an expansion in elementary functions. This method is used to interpret measurements obtained with the SNAC 50 system: four activation detectors (Au, Cu, S and Mg) are placed underneath a cadmium casing with two copper foils in contact with the casing. The counting is carried out under standard conditions. Processing of the measured data is performed, either using a computer and the SNAC 003 code or manually with linear formulas. Modifications for different measurements and geometries are mentioned. (France)

15309 INFLUENCE OF THE POLE PIECE MATERIAL ON THE PROPERTIES OF A MAGNETIC BETA SPECTROMETER. Mampe, W.; von Egidy, T. (Technische Univ., Munich). Nucl. Instrum. Methods; 97: No. 3, 609-10(1971).

The influence of the magnetic material on the resolution and line position of an iron-magnet beta spectrometer has been investigated. Relative line shifts for pole pieces made of pure iron and of mu-metal both for manual and automatized magnetization are presented. (auth)

15310 CONVERSION ELECTRONS SEPARATED FROM HIGH BACKGROUND. Van Klinken, J.; Wisshak, K. (Kernforschungszentrum, Karlsruhe, Ger. Univ., Heidelberg). Nucl. Instrum. Methods; 98: No. 1, 1-8(1972).

A mini-orange-type combination of permanent magnets can separate electrons from positrons. Used as a filter in front of a Si(Li) detector, the magnet system enhances the detection efficiency of conversion electrons and suppresses the influence of β^+-, α-, p- and γ-radiation. It improves peak-to-background ratios by a factor of up to 80. The system has been applied for energies between 0.03 and 1 MeV, using different magnet configurations. The corresponding transmission curves have full widths at half maximum between 0.15 and 0.4 MeV. (auth)

15311 POLARIZATION MEASUREMENTS OF RESONANTLY SCATTERED CAPTURE GAMMA RAYS. Moreh, R.; Rajewski, J. (Nuclear Research Centre, Negev, Israel). Nucl. Instrum. Methods; 98: No. 1, 13-20(1972).

A Compton polarimeter for measuring the linear polarization of resonantly scattered neutron-capture γ-rays in the energy region 4 to 9 MeV is described. The performance of this system as a function of photon energy for perfectly polarized radiation is given. It is shown that reliable information regarding the parities of the resonance levels and the quadrupole-dipole mixing ratios of high energy transitions may be obtained from these measurements. (auth)

15312 SELF- AND FOIL-ABSORPTIONS OF LOW ENERGY INTERNAL CONVERSION ELECTRONS IN $4\pi\beta$-COUNTING. Kawada, Y. (Electrotechnical Lab., Tokyo). Nucl. Instrum. Methods; 98: No. 1, 21-7(1972).

By means of the $4\pi e$-X coincidence method and simple $4\pi e$-counting, the self- and foil-absorptions of low energy internal conversion electrons from ^{103}Ru–^{103m}Rh (16.8 keV), ^{127m}Te (56.9 keV) and ^{99m}Tc (120–142 keV) were measured for sources prepared by deposition from radioactive solutions with several different carrier concentrations. The minimum self-absorption obtained by the use of colloidal silica can be kept within a few tenths of 1% for 56.9 keV electrons. However, for 16.8 keV electrons, it amounts to about 5%. Although the absorption by the source-mount depends considerably upon the self-absorption, it remains small enough when an ordinary VYNS backing is used. The experiments include the measurements of the self-absorption of β rays from various nuclides which were made in order to check the universality of the source preparation techniques. (auth)

15313 ANALYSIS OF COLD NEUTRON TIME-OF-FLIGHT SPECTRA USING DIRECT FAST FOURIER TRANSFORMATION. De Mul, F. F. M.; Bregman, J. D. (Interuniversitair Reactor Instituut, Delft, Netherlands). Nucl. Instrum. Methods; 98: No. 1, 53-60(1972).

A method to separate quasi-elastic and inelastic cold neutron scattering, measured with the time-of-flight technique, using fast Fourier transforms, is described. The influence of filtering transformed functions upon the deconvolution of time-of-flight spectra is analysed on the basis of some examples. (auth)

15314 NEUTRON SPIN-FLIP-CHOPPER WITH HIGH REPETITION RATES. Freisleben, H.; Rauch, H. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 98: No. 1, 61-7(1972).

A pulsed neutron beam behind the analyzer of a polarized neutron spectrometer is obtained by periodically switching on and off the high frequency field of a resonance spin-flip coil. By means of this electronic method neutron bursts with repetition rates up to 25 kc, arbitrary duty cycles and high peak intensity are produced. The wavelength resolution—determined by the double Bragg reflection—is $\Delta\lambda/\lambda$ = 2.4% and the time resolution at the largest flight path used (545 cm) is 2.6%. An elaborate electronic system effects that the unsharpness of time caused by the electronic chopper system is smaller than the contribution through the wavelength dispersion. (auth)

15315 EFFECT OF SPECTRUM SMOOTHING ON PEAK AREA DETERMINATIONS. Tominaga, H.; Dojyo, M.; Tanaka, M. Japan Atomic Energy Research Inst., Oarai). Nucl. Instrum. Methods; 98: No. 1, 69-76(1972).

The effect of a smoothing by digital filter on the determination of spectral peak areas has been studied quantitatively by means of the numerical experiments with a computer. Gaussian shape filters were employed. For the method of Covell's partial peak area determination, the least-squares analysis using a standard peak, and the subtraction of polynomial background, statistical and systematic errors are comparatively observed especially in the case of a single small peak on the curved background. (auth)

15316 CALIBRATION OF A COINCIDENCE GAMMA-RAY SPECTROMETER FOR DIRECTIONAL CORRELATION STUDIES. Jagam, P. (Saint Mary's Univ., Halifax, Can.); Murty, D. S.; Lakshminarayana, V. Nucl. Instrum. Methods; 98: No. 1, 77-85(1972).

Quality Ge(Li) detectors of large volume make it possible to determine the correlation coefficients in directional correlation studies with an accuracy greater than ever before. In this connection, the corrections to be applied to the experimentally determined coefficients, for various deviations from the ideal case, are examined in detail. Explicit formulae are compiled as extensions to earlier work, for specific application to gamma–gamma directional correlation studies. It is considered that the geometrical attenuation factors for Ge(Li) detectors are best determined experimentally. The collimated beam technique for the experimental determination of the same is investigated with respect to increasing the beam size. Suitable formulae to correct for the beam size effects are also proposed. The case of shielded detector geometries and the peculiarities associated with such applications are illustrated in the investigation with ^{99}Mo. (auth)

15317 DOUBLE CHOPPER SPECTROMETER FOR COLD NEUTRONS. Westphal, G. P.; Rauch, H.; Breitfuss, G. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods; 98: No. 1, 87-92(1972).

A description of the new double chopper facility developed for the wavelength range from 4 to 16 Å and for the use in solid and liquid state research is given. It consists of two phased triple-slotted rotors made of steel and laminated epoxy with added boron. The high content of hydrogen and boron provides good shielding properties against fast neutrons. Divergent slits are used to increase the transmission. The rotor diameter is 30 cm and the operational speed can be varied from 3000 to 12000 rev/min. The wavelength resolution $\Delta\lambda/\lambda$ can be changed from 2.7% to 15% by varying the distance between the chopper units. The motors are phase-controlled by means of three-term controllers. The phase stability of the system is better than 0.04 degrees. Period and phase of the choppers may be preset manually or by an on-line computer. (auth)

15318 MONTE CARLO CALCULATION OF MULTIPLE SCATTERING IN A COMPTON POLARIMETER. Lichtenberg, W.; Przybylski, A. (Univ., Wuerzburg, Ger.). Nucl. Instrum. Methods; 98: No. 1, 99-104(1972).

Energy resolution and polarization sensitivity of a Compton polarimeter are usually calculated for singly scattered photons, and the influence of multiple scattering is neglected. To realize the effects of multiple scattering the spectra of the multiply scattered photons are computed by the Monte Carlo method for primary photon energies of 30 keV to 1 MeV and cylindrical scatterers of different size. The spectra can be approximated by a simple formula. (auth)

15319 OPTIMIZATION PROBLEM IN TIME-OF-FLIGHT SPECTROSCOPY. Weise, K. (Physikalisch-Technische Bundesanstalt, Brunswick). Nucl. Instrum. Methods; 98: No. 1, 119-24(1972).

The solution is given of the optimization problem in slow neutron time-of-flight spectroscopy, stated by Wilhelmi and Gompf, in order to find the chopping device minimizing the total statistical error of the measurement under most general assumptions. The pseudo-statistical sequences turn out to be most suitable for beam modulation not only within the set of binary sequences but also in general. There is an equally useful new class of quasi-binary sequences closely related to the Legendre type binary ones. (auth)

15320 MONTE CARLO PROGRAM FOR CALCULATING THE PROBABILITY INFORMATION FOR A COINCIDENCE SPECTROMETER FOR POSITRON ANNIHILATION RADIATION FOR POINT-, DISK-, AND CYLINDER-SHAPED PROBES. Bissem, H. (Univ., Hamburg). Nucl. Instrum. Methods; 98: No. 1, 147-50(1972). (In German).

Coincidence counting efficiencies and absorption factors of a coincidence spectrometer with two NaI(Tl) scintillation crystals in line were calculated for the case of β^+-annihilation radiation. (auth)

15321 GALLIUM ARSENIDE SURFACE BARRIER DETECTORS. Kobayashi, T.; Sugita, T. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Nucl. Instrum. Methods; 98: No. 1, 179-80(1972).

Gallium arsenide surface barrier detectors made from high purity GaAs wafer have been operated as α-particle, β-ray and γ-ray detectors. Resolutions observed were 21.35 keV and 13.5 keV for 5.486 MeV α particles from ^{241}Am and 115 keV conversion electrons from ^{57}Co, respectively, at room temperature. For 122 keV γ-ray from ^{57}Co the resolution obtained at room temperature was 15 keV (fwhm). (auth)

15322 TECHNIQUE OF DETECTING CONVERSION ELECTRONS. Fruscello, T. W.; Cothern, C. R. (Univ. of Dayton, Ohio). Nucl. Instrum. Methods; 98: No. 1, 181-2(1972).

The resolution of a 50 mm^2 Si(Li) detector, suitable for operation at room temperature, was improved more than four times by cooling it to −32°C with the use of a thermo-electric device. Resolution measurements were made for the 0.972 MeV electron in the decay of ^{207}Bi. Data were taken using different bias voltages at various temperatures to obtain the optimum operating conditions for the detector. A copper water bath was used as a heat sink for the cooling module, affording reliable performance of not only the module but also the detector for long periods (weeks) of continuous running. (auth)

15323 LIQUID HELIUM POLARIMETER OF UNIQUE DESIGN. Birchall, J.; Blyth, C. O.; Dunscombe, P. B.; (and others) (Univ. of Birmingham, Eng.). pp 43-7 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

A polarimeter for the precise measurement of neutron beam polarization in the energy range 2 to 20 MeV is described. The essential requirements of such a device and the way in which these requirements influence the final design are discussed. A resolution of 12% was obtained for 9-MeV alpha particles. (2 figures) (R.W.R.)

High Energy Physics Instrumentation

15324 (ANL/HEP-7128) POLLY III: A FOUR-VIEW SYSTEM FOR ANALYZING FILM FROM LARGE BUBBLE CHAMBERS. Beck, F. (Argonne National Lab., Ill.). Aug 1971. 40p. Dep. NTIS.

POLLY is a cathode-ray-tube scanner of high precision, controlled by an on-line computer, and having extensive facilities for help from a human operator. Full use is made of the ability to look at any small part of the picture in great detail, and automatic event-finding and measurement have been performed on a production scale. The system has the advantage that predigitizing, measuring, filtering, and any necessary manual patching can all be performed in one operation. POLLY III, which is described in some detail, is the latest of a series of film scanners built at Argonne, and has been designed primarily for use with four-strip 70 mm film from the Argonne 12-foot hydrogen bubble chamber, but use with film from the projected large chamber at the National Accelerator Laboratory and the big European chambers has been considered. (auth)

15325 (CEA-N-1495) DATA SELECTION AND ACQUISITION FOR MEASURING THE SPIN ROTATION PARAMETERS IN HIGH-ENERGY π^-p SCATTERING. Raoul, Jean-Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1971. 114p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The polarization of the recoil protons arising from the elastic scattering of positive or negative pions by a polarized $La_2Mg_3(NO_3)_{12}24H_2O$ crystal target was measured. The measurements were made with a polarimeter consisting of a pile of carbon plates alternated with wire spark chambers. The associated electronics has the following characteristics: selective triggering of the spark chambers, acquisition and transcription on magnetic tape of all relevant information, and the continuous monitoring of the correct working of all parts of the equipment. Information on the geometry of the π−p scattering is provided by about 100 scintillation counters, the information being handled by a fast logic circuitry. This circuitry, which is in the form of integrated circuits, generates the selective trigger with a transit time of less than 150 nsec. It reduces the triggering rate on background events by almost an order of magnitude. A small computer is used for the data acquisition and the control of the experiment. (France)

15326 (CERN-Trans-71-33) COMMAND SYSTEM FOR TRANSPORT MECHANISM OF HPD FILM. Gerasimov, B. Ya.; Zaitsev, L. F.; Ivanov, A. A.; Proskuryakov, Yu. T. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Ser-

pukhov. Institut Fiziki Vysokikh Energii). Translated by M. Besrukoff (CERN, Geneva, Switzerland), from report IFVE-SPK-70-33. 23p. (In French). Dep. NTIS (U. S. Sales Only).

A control system for the transport mechanism of HPD film, analogous to a flying-spot digitizer, was designed. The principles of the system and the basic operation of the film transport mechanism are described. The system used for the detection of the Brenner marks is discussed. The circuit for the formation of the speed signals, the circuit for the formation of auxiliary signals, the circuit for the control of the gates and brakes, and the circuit for the adaptation of the operator amplifier to the modulator by variation of the pulse length are given. The operational regime and typical experimental data are described. (J.S.R.)

15327 (ITEF-807) USE OF PULSED X RADIATION FOR DETERMINING THE CHARACTERISTICS OF A NARROW GAP SPARK CHAMBER. Kanavets, V. P.; Martynov, V. I.; Ryltsov, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1970. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The preliminary results of the use of pulsed x radiation as a method for investigating the characteristics of a narrow gap spark chamber and control of its operation are reported. The principles of the preferred method consist in the possibility of miniaturizing the wide working circle of the chamber. It is shown that the use of pulsed x radiation permits the reproduction of detector characteristics, especially for relativistic charged particles, with satisfactory precision. (tr-auth)

15328 (KHFTI-70-41) TOWARD A DETERMINATION OF THE KINEMATIC PARAMETERS OF A CHAMBER PARTICLE. Adushkina, R. I.; Bezruk, A. I.; Zinov'yeva, O. G.; Koltunov, I. A.; Rovinskaya, A. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1970. 32p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new and improved method for determining the parameters of a bubble chamber particle taking into account the nonuniformities of the chamber magnetic field, the ionization losses, the optical system distortions, and multiple Coulomb dispersion is proposed. The program realizing this algorithm in the electronic computer "M-220" was verified in detail in two thousand modeled tracks. The results of the check led to the conclusion that there are practically no system errors in determining the kinematic parameters for exclusion of random factors (such as multiple dispersion and measurement errors). (JPRS)

15329 (LNF-71/27) CHARACTERISTIC PROPERTIES AND USE OF A PROPORTIONAL WIRE CHAMBER. Fabbri, B.; Zanella, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 7 Jun 1971. 21p. (In Italian). Dep. NTIS (U. S. Sales Only).

The functioning of a proportional wire chamber is summarized. The voltage pulse caused by a local ionization is described. The detection of an ionized track and its geometric definition with the induced positive pulses, energy resolution and amplitude analysis of the pulse of an ionized track, time resolution, and spatial resolution of a proportional wire chamber are discussed. Its construction is outlined. The selection of a particle coming from a diffuse source is calculated. (J.S.R.)

15330 (NP-19172) MULTIPLE SCATTERING AND TRACK RECONSTRUCTION. Laurikainen, Petri (Helsinki Univ. (Finland). Dept. of Nuclear Physics). Oct 1971. 25p. Dep. NTIS (U. S. Sales Only).

Thesis.

Due to multiple scattering, the curve-fitting methods of THRESH and other standard geometrical-reconstruction programs are not the most efficient type of track estimators. A review is given on some approaches to improve these methods. The distribution theory of small-angle scattering relevant to the problem is reviewed, with emphasis on the statistical nature of scattering processes. Tracks in hydrogen bubble chambers are considered as an example. (auth) (Finland)

15331 (ORO-2504-175) PSEUDOCUMENE BASED LIQUID SCINTILLATOR. Technical Report No. 72-031. Aitkenhead, Wm.; Crouch, J. H.; Risk, W. S. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Sep 1971. 20p. Dep. NTIS.

Properties of a liquid scintillator using pseudocumene as a solvent are described. The scintillator has a much higher light output than mineral oil based liquid scintillators and is very inexpensive when the user mixes it himself. The scintillator can be used in acrylic plastic containers and is not much more volatile than mineral oil, but some care must be used in handling it. The detector was developed for use in a system to measure the threshold cross sections for $\pi^{\pm} + p \rightarrow \pi^{\pm} + \pi^{+} + n$ interaction. (auth)

15332 MEASUREMENT OF ELECTRON ENERGY WITH DISCRIMINATION AGAINST HADRONIC BACKGROUND. Blumenfeld, B. J. (Columbia Univ., N. Y. Brookhaven National Lab., Upton, N. Y.); Lederman, L. M.; Cool, R. L.; Segler, S. L. Nucl. Instrum. Methods; 97: No. 3, 427-31(1971).

Data are presented on a configuration of a Pb glass Cherenkov detector which detects high energy electrons with high efficiency, measures their total energy and discriminates strongly against hadronic background. Energy resolution and discrimination ratios are given for electron and hadron energies between 5 and 20 GeV. (auth)

15333 MEASUREMENT OF ENERGIES USING A GLASS-SCINTILLATOR IONIZATION SPECTROMETER. Gillespie, C. R.; Huggett, R. W. (Louisiana State Univ., Baton Rouge). Nucl. Instrum. Methods; 97: No. 3, 515-21(1971).

A method is described for obtaining the energies of high energy hadrons incident upon a glass-scintillator ionization spectrometer. (auth)

15334 ALTERNATE POLARITY MULTIPLE SPARK GAP FOR HIGH EFFICIENCY SHOWER DETECTORS. De Marzo, C. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Guerriero, L.; Nicolini, C.; (and others). Nucl. Instrum. Methods; 97: No. 3, 539-45(1971).

The developments in the hv pulsing system which have been made in order to reduce the rise time and the delay of the hv pulse at the plates of a large spark chamber system are reported. Higher efficiency has been achieved feeding each chamber through an alternate polarity multiple spark gap. (auth)

15335 CALCULATED PULSE HEIGHT SPECTRUM OF A TWO PARTICLE SCINTILLATION COUNTER. Wright, P. J. (Univ. of Southampton, Eng.). Nucl. Instrum. Methods; 98: No. 1, 93-7 (1972).

A double convolution function is derived for the pulse height spectrum of a scintillation counter required to select two particle events over a wide acceptance angle. Two simple methods for calculating the solid angle of a square telescope are included in the appendix. (auth)

15336 COMPARISON OF THREE TOTAL ABSORPTION GAMMA SPECTROMETERS. Prentice, M. N.; Railton, R.; Stewart, D. T. (Univ. of Glasgow). Nucl. Instrum. Methods; 98: No. 1, 135-9(1972).

Three total absorption shower cascade detectors, consisting of blocks of cadmium fluoride, lead fluoride and lead glass of similar dimensions viewed by photomultipliers, have been investigated up to 3.5 GeV on the test beam at Daresbury Nuclear Physics Laboratory. At 1 GeV the energy resolution of the cadmium fluoride detector was found to be 19% (fwhm) compared with 34% for the other two. This superior resolution arises from the fact that the response of cadmium fluoride is mainly due to scintillation compared with the pure Cherenkov response of the other two detectors. However, above 1 GeV the Cherenkov detectors exhibit a more linear variation of pulse height with energy. (auth)

15337 SUPERCONDUCTING MAGNETIC SPECTROMETER FOR COSMIC RAY NUCLEI. Smith, L. H.; Buffington, A.; Wahlig, M. A.; Dauber, P. (Univ. of California, Berkeley). Rev. Sci. Instrum.; 43: No. 1, 1-11(Jan 1971).

The design, calibration, and operation of a magnetic spectrometer for particle astronomy are described. The spectrometer consists of a superconducting magnet, optical spark chambers, scintillation detectors, and associated electronics. The instrument has been flown in a balloon gondola to 4.8 g/cm^2 residual atmosphere, where it was used to analyze the charge and differential rigidity spectra of primary nuclei from 5 to 100 GeV/c. (auth)

15338 VARIABLE-THRESHOLD INTEGRATED PREAMPLIFIER FOR MAGNETOSTRICTIVE SIGNALS. Goggi, G. (Univ., Pavia, Italy. Istituto Nazionale de Fisica Nucleare, Pavia, Italy); Ornati, C. M. Nucl. Instrum. Methods; 98: No. 2, 367-9(1972).

A simple integrated circuit version of a preamplifier for magnetostrictive signals is described. Typical threshold is 2 mV with less than 50 μV/°C temperature coefficient. Different measurements are reported. (auth)

15339 DESIGN AND PERFORMANCE OF A GAS CHERENKOV COUNTER WITH SPATIAL RESOLUTION. Ashford, V.; Masek, G.; Maung, T.; (and others) (Univ. of California, San Diego, La Jolla). Nucl. Instrum. Methods; 98: No. 2, 215-20(1972).

The design and performance of a threshold gas Cherenkov counter used for detecting electrons in experiments of K_{e3} decays and hyperon leptonic decays are described. The counter has a degree of spatial resolution, i.e. it can resolve the azimuthal angle of the electron trajectory to ±7.5°. (auth)

15340 LEAST SQUARES FIT OF BUBBLE CHAMBER TRACKS TAKING INTO ACCOUNT MULTIPLE SCATTERING. Laurikainen, P. (CERN, Geneva); Moorhead, W. G.; Matt, W. Nucl. Instrum. Methods; 98: No. 2, 349-59(1972).

A new approach to the problem of taking into account multiple scattering when making the least squares fit of bubble chamber tracks to film measurements is presented. For completeness, the more refined version of the standard fit which has been developed for the new large hydrogen bubble chambers, is also described. In the standard fit, energy loss and inhomogeneity of magnetic field only are taken into account, and five parameters are fitted. In the new method, the scattered track is followed more closely by introducing additional parameters each with known mean and variance. The amount of additional computation depends directly on the total multiple scattering deviation expected. The method is particularly useful for connecting tracks, as the parameters at the two vertices are fitted simultaneously. (auth)

15341 DATA-ACQUISITION SYSTEM FOR A LARGE WIRE CHAMBER SPECTROMETER. Coombes, R. (Stanford Univ., Calif.); Fryberger, D.; Hitlin, D.; (and others). Contract No. F44620-67-C-0070. Nucl. Instrum. Methods; 98: No. 2, 317-28(1972).

A large wire chamber spectrometer for the study of neutral K-meson decays has been constructed. The construction and performance of the wire chamber and high voltage pulsing system and the readout and data-acquisition systems are described. (auth)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

Refer also to abstracts 16774 and 16791.

15342 (CONF-711124-1) NUCLEAR RADIATION ENHANCEMENT OF CO_2 LASER PERFORMANCE. Ganley, T.; Verdeyen, J. T.; Miley, G. H. (Illinois Univ., Urbana). [1971]. 6p. Dep. NTIS.

From second symposium on uranium plasmas; Atlanta, Ga. (15 Nov 1971).

The effect of nuclear radiation on the operation of electrically excited CO_2 lasers is discussed. Three types of experiments and results are presented: (1) low-pressure CW laser; (2) low-pressure pulsed laser; and (3) high-pressure TEA pulsed laser. (auth)

15343 (UCRL-73477) LINEAR DISPLACEMENT TRANSDUCER FOR SEVERE ENVIRONMENT APPLICATIONS. Pruner, John W. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Nov 1971. 11p. (CONF-711208-3). Dep. NTIS.

From Underground nuclear test measurements symposium; Albuquerque, N. Mex. (7 Dec 1971).

A linear displacement transducer has been developed to provide both active and passive impulsive measurements of small material samples exposed to nuclear radiation. The transducer is designed to operate in an underground nuclear blast environment where sample velocities to 200 in/sec and high accelerations are encountered. Actively, the transducer provides a pulse-amplitude-modulated analog output signal for recording of linear displacement with time data. Crushable honeycomb is utilized to provide a passive measure of the kinetic energy of a moving mass. Secondary honeycomb crush due to shock loading of the transducer support structure is limited by the application of a unique self-locking design feature. Design innovations to facilitate shipping, handling, installation and field calibration are incorporated into the transducer configuration. Transducer performance is evaluated under controlled laboratory conditions. (auth)

15344 ANNEALING MEASUREMENTS OF X-IRRADIATED MOSFET'S. Kreutz, E. W.; Pagnia, H.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). pp V117-28 of International Conference on the Physics and Chemistry of Semiconductor Heterojunctions and Layer Structures. Vol. V. /Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971).

From International conference on the physics and chemistry of semiconductor heterojunctions and layer structures; Budapest, Hungary (11 Oct 1970).

Changes of drain current and of transfer characteristics were measured during x-irradiation in commercially available n-channel field-effect transistors of the metal/oxide/semiconductor configuration. The drain current increases at 79°K with irradiation time. The thermal annealing characteristics of x-ray-induced changes are presented. Possible mechanisms of the radiation effects and the model of thermal annealing in the MOSFET's are discussed. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 14707, 15066, 15631, 17109, and 17132.

15345 (ANCR-1016, pp 401-535) TECHNIQUES AND INSTRUCTIONS. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

COMPUTER PROGRAMS—development at NRTS, Oct. 1971
GAMMA SPECTROMETERS—development at NRTS, Oct. 1971
NEUTRON SPECTROMETERS—development at NRTS, Oct. 1971
RADIATION DETECTORS, ACTIVATION—development of metal alloy, for neutron spectrum measurements
REACTOR FUEL ELEMENTS—cladding for, x-ray fluorescence spectroscopy measurement of thickness of
—cladding for, CFRMF beta autoradiography method for measurement of thickness of
REACTORS, RESEARCH—physics calculations for CFRMF
SNOW—density profile and moisture content of, control software for telemetered radiometric gages for measuring (TSS)

15346 (CEA-R-4236) CALCULATION OF THE RELATION BETWEEN THE INPUT AND OUTPUT AMPLITUDE FOR RANDOM PULSES AND THE CIRCUIT PULSE RESPONSE IN ORDER TO DETERMINE THE MEASUREMENTS TO BE MADE ON LINEAR CIRCUITS AND THE GENERATOR STABILITY REQUIRED. Jollec, Claude; Kermorgant, Joseph; Ringeard, Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1971. 45p. (In French). Dep. NTIS (U. S. Sales Only).

The effect of the average pulse rate and amplitude variations at the output of a linear circuit with an impulse response h(t) is evaluated. Calculations are made for two filters: one CR differentiation and n RC integrations; and two CR differentiations and n RC integrations. The amplitude and the average pulse rate stability are deduced for a generator designed to simulate a radioactive source, used for measuring the characteristics of linear circuits in the presence of random pulses. This leads to the definition of the parameters to be measured and the measurements to be made. Some experimental results are presented. (auth)

15347 (CONF-680423-, pp 147-51) LOW LEVEL TRITIUM COUNTING. Moreno y Moreno, Augusto (Universidad Nacional Autonoma de Mexico, Mexico City). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The cell used for the electrolytic concentration of low-level tritium samples and the shielding of the anticoincidence measurement cells are briefly described. (J.S.R.)

15348 (CONF-680614-, pp 194-217) EVALUATION OF THE BAUSCH AND LOMB RESEARCH II METALLOGRAPH. Crouse, R. S.; Gray, R. J. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The Bausch & Lomb Research II was introduced in 1965. The earlier style, the Bausch & Lomb Research I has been in use by many laboratories for over 25 years. Since the capabilities of the older style instrument is relatively well known, basic comparisons of the two instruments are presented. The instrument was evaluated on the bases of mechanical design, convenience of operation, optical resolution performance in all the available illumination modes (bright field, dark field, polarized light, sensitive tint, and phase contrast), and color photography. Some shortcomings were found and means of coping with some of them were devised. The Research II metallography was found to be a superior instrument in most ways, with the promise of being even better as better lenses are developed and design and assembly bugs are worked out. (auth)

15349 (LA-DC-13313) TIME DOMAIN REFLECTOMETRY FOR STRAIN AND MANGANIN GAUGE SENSING. Fullwood, R. R. (Los Alamos Scientific Lab., N. Mex.). [1971]. 9p. (CONF-711208-1). Dep. NTIS.

From Underground nuclear test measurements symposium; Albuquerque, N. Mex. (7 Dec 1971).

The time domain reflectometry (TDR) technique was investi-

gated for sensing the dynamic resistance of piezo-resistive gauges used for stress or strain measurements. The technique has the advantage of presenting calibration and base-line information directly on the shot record by time-sharing, but has the disadvantage of reducing the frequency response of the recording by about a factor of three. The TDR method also suffers from the practical problem of the production of fast, high-voltage pulses at a high repetition rate. Experimental laboratory measurements are presented. The more conventional pulsed bridge is investigated from a pulse-propagation viewpoint and is found to be correct in principle, but sometimes wrong in practice. (auth)

15350 (LIB/Trans-390) REMOTE CONTROL OF A POLARISED NEUTRON GONIOMETER BY MEANS OF A SMALL COMPUTER. Ledebt, Ph.; Poussin, M.; Muttel, J.; Roudaut, E. Translated by P. Newton (Australian Atomic Energy Commission), from Bull. Inform. Sci. Tech. (Paris); No. 143, 15-19(Dec 1969). 6p. (CONF-690626-3). Dep. NTIS (U. S. Sales Only).

From Meeting on automation in nuclear research and industry; Grenoble, France (24 Jun 1969).

An abstract of this article prepared from the original language appeared as NSA 24: 16937(1970).

15351 (RDT-C-7-15-T(1-72)) THERMOCOUPLE CONNECTORS AND THERMOCOUPLE CONNECTOR PANELS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 8p. RSO.

A standard prescribing requirements for line-to-line thermocouple convectors and assemblies of one or more connectors mounted on a panel forming a rigid mount to line connection is given. (W.H.K.)

15352 (RDT-C-10-1-T(11-71)) THERMOCOUPLE SIGNAL TRANSMITTER. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Nov 1971. 17p. RSO.

This standard establishes the requirements for design, manufacture, testing and quality assurance of thermocouple signal transmitters and related services and equipment. Sensor signal transmitters convert dc millivolt signals from thermocouples into higher level standardized signals for transmitting to other equipment at locations which are remote from the transmitter. (auth)

15353 (RDT-C-10-2-T(11-71)) PERMANENT MAGNET FLOWMETER SIGNAL TRANSMITTER. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Nov 1971. 15p. RSO.

This standard establishes the requirements for design, manufacture, testing and quality assurance of permanent magnet flowmeter signal transmitters and related services and equipment. Sensor signal transmitters convert dc millivolt signals from permanent magnet flowmeters into higher level standardized signals for transmitting to other equipment at locations which are remote from the transmitter. (auth)

15354 (RDT-C-10-4-T(10-71)) SIGNAL SUMMER. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Oct 1971. 15p. RSO.

This standard establishes the requirements for design, manufacture, testing and quality assurance of signal summers and related services and equipment. Signal summers receive two or more signals as inputs and provide an output signal proportional to the sum of the inputs. (auth)

15355 (RFP-1778) RESPONSE OF FILM/CONVERTER COMBINATIONS TO 14.3 MeV NEUTRONS FOR FAST NEUTRON RADIOGRAPHY. Vasilik, Dennis G.; Murri, Richard L.; Salazar, Estevan S. (Dow Chemical Co., Denver, Colo. Rocky Flats Div.). 13 Jan 1972. Contract AT(29-1)-1106. 7p. Dep. NTIS.

The direct method for producing radiographic images with neutrons of approximately 14.3 MeV is considered. The source of neutrons is a sealed-tube neutron generator which has a yield of about 6.36×10^{10} n/sec. In the direct method, x-ray film is placed between calcium tungstate ($CaWO_4$) fluorescent screens. A hydrogenous converter screen is used to stimulate light emission in the fluorescent screens by means of recoil hydrogen atoms. The response of Kodak Royal Blue film to fast neutrons is discussed for various fluorescent-screen/converter-material combinations. Film exposure density is investigated as a function of both source-object distance and exposure time. Three converter materials investigated include Lucite, Bakelite, and magnesium-phenolic screens. Optimum results are achieved with a film-Lucite combination. (auth)

15356 (UCRL-73476) MULTIPLEX SYSTEM FOR USE WITH LINEAR DISPLACEMENT TRANSDUCERS. Alrick, K. A. (California Univ., Livermore. Lawrence Livermore Lab.). Nov 1971. 12p. (CONF-711208-4). Dep. NTIS.

From Underground nuclear test measurements symposium; Albuquerque, N. Mex. (7 Dec 1971).

A system which serially interrogates and digitally records the signals from a large number of linear displacement transducers is described. The 200-nanosecond interrogating pulses are amplitude modulated by the transducers and are mixed onto a single coaxial cable, reducing the number of downhole cables required. The signals from the transducers are then digitized and recorded on a magnetic disc along with timing information and a zero time reference signal. Total recording time is 33 milliseconds and during this time 132,000 data points are stored on the disc. Time resolution of the system depends upon the number of channels to be recorded. Amplitude resolution is 1% of full scale. Data may be read from the disc in two different formats. The data can be plotted vs time on a digital strip chart recorder or the data can be punched on paper tape for input to the data reduction facility. The system is located in an 8′ × 40′ van and has been successfully used on several events at the Nevada Test Site. (auth)

15357 (WCAP-7819) TEST REPORT NUCLEAR INSTRUMENTATION SYSTEM ISOLATION AMPLIFIER. Lipchak, J. B.; Bartholomew, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1972. 28p.

A detailed description of the isolation amplifier used in the nuclear instrumentation system is presented, and the results of in-circuit testing of the isolation capabilities of the prototype amplifier are presented. The test results demonstrate that the unit will provide the required isolation—there being no effect on the input (protection) circuit when the output (non-protection) circuit is subjected to shorts or the application of 120 VAC and ±150 VDC. (auth)

15358 (WCAP-7819(Rev.1)) TEST REPORT NUCLEAR INSTRUMENTATION SYSTEM ISOLATION AMPLIFIER. Lipchak, J. B.; Bartholomew, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa.). [nd]. 29p.

A description of the isolation amplifier used in the nuclear instrumentation system is given, and the results of in-circuit testing of the isolation capabilities of the prototype amplifier are presented. The test results demonstrate that the unit will provide the required isolation—there being no significant effect on the input (protection) circuit when the output (non-protection) circuit is subjected to shorts or the application of 120 VAC or ±150 VDC. (auth)

15359 INFLUENCE OF THE FINITE DIMENSIONS OF A RECTANGULAR HALL PROBE IN MEASURING THE NORMAL COMPONENT OF FIELDS OF 2 OR 3 COMPONENTS. Turck, R. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 97: No. 3, 587-95(1971). (In French).

Though a rectangular Hall plate is calibrated with a good accuracy (10^{-4}) in a homogeneous field, its performances are strongly degraded in an inhomogeneous field, not only in a 3 component one (planar Hall effect) but also in a 2 component one. That is to say, for a component in the plane of the probe parallel to an edge. This phenomenon is related to the action of the planar field component on the transversal magnetoresistivity in the neighborhood of the electrodes. These new boundary conditions entail an increase in the sensitivity of the probe considering the perpendicular component. As a solution, a semiempirical expression of the output voltage is proposed. (auth)

15360 PROPOSED RECOIL MASS SPECTROGRAPH FOR DETECTING SUPERHEAVY NUCLEI. Enge, H. A.; Betz, H. D.; Buechner, W. W.; (and others) (Massachusetts Inst. of Tech., Cambridge). Nucl. Instrum. Methods; 97: No. 3, 449-57(1971).

A new type of mass spectrograph is being proposed for separating and identifying nuclei recoiling from a thin target bombarded with heavy ions. The scheme is aimed principally at superheavy nuclei produced in fusion reactions, e.g., $^{144}_{62}Sm + ^{130}_{52}Te$, but it can also be used for lighter elements, e.g., for detecting proton-rich nuclei, such as products of the reaction $^{40}_{20}Ca + ^{40}_{20}Ca$. The apparatus planned consists of a crossed-field velocity selector, deflecting horizontally, followed by a broad-range magnetic spectrograph deflecting vertically. The combination produces two-dimensional focusing and velocity focusing so that particles with constant M/q fall on sharp slanted lines on the detector with a relatively good mass resolution, independent of target thickness and beam homogeneity. The advantage of this scheme over a conventional Nier-type mass spectrograph for this purpose is that it can handle a large range of charge states of the recoiling nuclei. Preliminary plans for also determining Z of the recoiling nuclei include stopping-power or range measurements and detection of characteristic X-rays emitted either in the stopping process or following decay. (auth)

15361 FORCED-REFLECTION COLLIMATORS AND THE n–n SCATTERING EXPERIMENT. Spencer, L. V. (National Bureau of Standards, Washington, D. C.); Woolf, S. Nucl. Instrum. Methods; 97: No. 3, 567-76(1971).

An approach to neutron collimator design is suggested in which wall-emergent neutrons are forced to reflect from the surface of each (tapered) segment beyond the point of emergence. Designs of this type, together with a suggested design for a proposed neutron-neutron scattering experiment, are compared in simple Monte Carlo and analytic studies. (auth)

15362 TIME-OF-FLIGHT SPECTROMETER FOR MASS IDENTIFICATION OF HEAVY IONS. Dietz, E.; Bass, R.; Reiter, A.; Friedland, U.; Hubert, B. (Univ., Frankfurt am Main). Nucl. Instrum. Methods; 97: No. 3, 581-6(1971).

A time-of-flight system for the mass identification of heavy ions has been set up and tested. The zero-time detector is based on the well known principle of accelerating secondary electrons from a thin foil onto a plastic scintillator. The properties of this detector and their dependence on various parameters are discussed. A standard Si detector is used to stop the ions. In test measurements with heavy ions at energies up to about 1 MeV per nucleon a time resolution of 0.5 ns and a mass resolution of 2% (fwhm) have been obtained. (auth)

15363 OPERATIONAL PROPERTIES OF CHANNEL-PLATE ELECTRON MULTIPLIERS. Soul, P. B. (Standard Telecommunication Labs., Ltd., Harlow, Eng.). Nucl. Instrum. Methods; 97: No. 3, 555-65(1971).

The electron-multiplication process in micro-channel plates is analyzed semi-quantitatively in a way that applies equally to channels of any cross-sectional shape. Good agreement is obtained with experimental measurements of channel-plate gain characteristics, particularly in the saturation region, where the shapes of the characteristics can be explained entirely in terms of charge depletion of the channel walls by the electron cascade. The analysis leads to improved methods for optimizing the performance of channel plates in image-intensifying devices. A simple procedure (based on measurements of the overall gain of a plate) is described for determining the applied voltage at which fixed-pattern image noise will be reduced to a minimum. The problems of shot noise, heat dissipation, and the measurement of the mean channel diameter in a plate are also discussed. (44 references) (auth)

15364 FURNACE FOR HIGH FIELD MOESSBAUER EXPERIMENTS. Coey, J. M. D.; Price, D. C.; Morrish, A. H. (Univ. of Manitoba, Winnipeg). Rev. Sci. Instrum.; 43: No. 1, 54-7(Jan 1972).

A vacuum furnace for Moessbauer effect experiments is described which fits into the 5 cm room temperature bore of a superconducting solenoid. The temperature homogeneity of the absorber, a disk 2.0 cm in diameter, is better than 0.25°C at 360°C. As an illustration of its use, the complete temperature dependence of the hyperfine fields at the five iron sites of $SrFe_{12}O_{19}$ has been determined. (auth)

15365 DIGITAL CORRECTOR FOR MULTICHANNEL COUNTING OF SHORT- AND MEDIUM-LIVED NUCLIDES. Goerner, W.; Peters, D.; Zschau, J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Instrum. Methods; 98: No. 2, 371-2(1972).

The device, using a digital e-function generator, compensates for dead-time and decay losses in counting nuclides with half-lives between 0.1 and 10^5 sec. (auth)

15366 HIGH RESOLUTION SINGLE CHANNEL PULSE AMPLITUDE SELECTOR. Ghelfan, P. (M. G. Electronics Ltd., Rehovot, Israel). Nucl. Instrum. Methods; 98: No. 2, 365-6 (1972).

A circuit with fast response was developed to improve the double pulse resolution of a single channel amplitude analyzer. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

15367 (CEA-CONF-1875) FRENCH PROGRAM FOR CARDIAC PACEMAKERS FED BY ^{238}Pu THERMOELECTRIC GENERATORS. Alais, M.; Berger, R.; Boucher, R.; Laurens, P.; Piwnica, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1971. 13p. (In French). (CONF-710444-5). Dep. NTIS (U. S. Sales Only).

From International conference on chemical sciences; Paris, France (20 Apr 1971).

The isotope battery group created by the European Nuclear Energy Agency to initiate research in the low-power range is particularly interested in the pacemaker problem. Under the guidance of the Delegation Generale a la Recherche Scientifique et Technique, and the Societe Alcatel, the CEA and the Broussais hospital, have developed a pacemaker conforming with the GIPSIE program (Generateur isotopique au ^{238}Pu pour stimulateur implantable electrosystolique). Following research on the heat source, the thermoelectric battery, and the stimulator itself, experiments were conducted with animals (1969), the first human implants being conducted in 1970. (France)

15368 (CEA-R-4217) OBTAINING OF HEAVY WATER BY THE DUAL TEMPERATURE H_2S PROCESS. Agostini, Jean-Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1971. 121p. (In French). Dep. NTIS (U. S. Sales Only).

Computer techniques were used to establish a mathematical model taking into account the main physical phenomena involved in the dual-temperature H_2S-H_2O separation process for the production of heavy water. A computer program based on this model was used to establish the effects of various physical parameters and led to the proposal of changes in the classical set up. (France)

15369 (KFK-1431) COST OF SEPARATIVE WORK IN ^{235}U ENRICHMENT IN INDUSTRIAL SEPARATION NOZZLE CASCADES. Schuette, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Jul 1971. 24p. (In German). Dep. NTIS (U. S. Sales Only).

The cost of separative work from separation nozzle cascades with separative capacities ranging from 8×10^5 to 10^7 separative work units per year (SWU/a) has been calculated on the basis of actual process performances and on a cost basis which has been evaluated for a separation nozzle demonstration plant ($\sim 6 \times 10^5$ SWU/a, ~400 MW). The calculations include variations of the elementary separation effect of isotope separation, ϵ_A, of the exponent governing the economy of scale within the cumulative cost function of a cascade, and of the price of electricity. For several strategies for increase in capacity, the separative work costs, the annual investments, and the total capital requirements are indicated on two different financial bases, A and B. The period of depreciation in both cases is 20 years; A implies a rate of interest of 8% per annum and B assumes 7% per annum for long term and 9% for short term capital charges. Medium size separation nozzle plants (2.5×10^6 SWU/a, ~1000 MW) will equal the present USAEC standard of $32.00 SWU if a 15% increase in the actual separation effect can be realized. Assuming 30% increase in the separation effect, the separative work charge in separation nozzle plants would figure below $27.00 SWU. In these calculations, a cost exponent of 0.7 was applied in extrapolating costs of cascade components beyond the range of flow rates (3×10^4 to 10^5 m^3/h) actually realized. A variation of this exponent in the range from 0.75 (power station cost scale) to 0.6 is of no substantial influence on the results. Several examples of cascade realization synchronized to three different patterns of separative work requirements are compared on a numerical and a graphical basis with regard to their time-cost relationships. For the separation nozzle cascades under consideration so far, the differences resulting from the two financial bases are in the order of 1%. As to the apparently advantageous cost figures for supersize enrichment plants, no special analysis has been made with respect to secondary cost handicaps depending on site conditions. (auth)

15370 (KFK-1439) DEPENDENCE OF THE COST OF SEPARATION IN A NOZZLE SEPARATION PLANT FOR ^{235}U ENRICHMENT ON THE LOAD CONDITIONS. Schubert, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Aug 1971. 40p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe, Ger.

In the separation nozzle method, the main expense is caused by the energy consumption of electrically-driven stage compressors. The price of electricity for large-scale consumers can be kept particularly low if the consumer is able to adapt his electricity requirements, within certain limits, to the utilization of the electricity grid which is subject to certain seasonal variations. Measures were investigated by which the load conditions and, hence, the electricity consumption of a separation nozzle plant can be modified with economic success. The compressor characteristics required for these studies were determined experimentally on a two-stage radial compressor fit for UF_6 use with a nominal suction capacity of 1×10^5 m^3/h. The characteristics of the separation nozzle required in addition were determined in laboratory scale tests with short sections of separation elements. It was shown that a change of gas pressure and gas temperature in the same direction is a particularly economical measure to adapt the electricity requirements of a separation nozzle plant to the utilization of the grid. (auth)

15371 (MLM-1879(TR)) MERCURY MASS-DIFFUSION COLUMNS FOR ISOTOPE SEPARATION. Nikolaev, B. I.; Kolokol'tsov, N. A.; Sulaberitsze, G. A.; Tevzadze, G. A.; Chuzhinov, V. A. Translated for Mound Lab., Miamisburg, Ohio, from Isotopenpraxis; 6: No. 11, 417-21(1970). 13p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 29277.

15372 (ORNL-tr-2570) ELECTROMAGNETIC SEPARATION OF THE ISOTOPES OF THE PLATINUM-PALLADIUM GROUP. Bochin, V. P.; Gavrilov, B. E.; Zolotarev, V. S. Translated by Joseph Lewin (Oak Ridge National Lab., Tenn.), from Isotopenpraxis; 7: No. 6, 232-5(1971). 12p. Dep. NTIS.

A newly-developed technique employing fluorination of the corresponding metal in the crucible of a standard ion source was applied in the electromagnetic separator of the Atomic Energy Institute to separate platinum, iridium, and ruthenium isotopes. Thus, the efficiency of the separating plant was increased by several tens of times compared with the method of separation employing high-temperature ion sources. The quality of separated isotopes as to their enrichment and chemical purity also by far surpassed the one obtained with the use of high-temperature equipment. (auth)

15373 DEFINITION OF THE PERFORMANCE OF ISOTOPE SEPARATION PLANTS AND THEIR ELEMENTS. Boehringer, A. (Gesellschaft fuer Nukleare Verfahrenstechnik, Bensberg, Ger.). Arch. Elektrotech. (Berlin); 54: No. 3, 127-39(1971). (In German).

Applying isotope separation methods of economic importance usually one elementary process is not sufficient to achieve the desired, larger change in isotopic abundance of the mixture of molecules fed in. Thus the problem arises to measure the benefit of a single element which contributes to the solution of a complete task. It is pointed out that efficiency in its physical meaning is not suited for this purpose and shown, using an example from electrical engineering, that the simple demand, asking the performance of a network to cumulate arithmetically from the performance of the elements of which it consists may be sufficient for the definition of a well-suited term. Transferring the demand of arithmetical cumulation on isotope separation plants then indeed yields a well-suited, easy conceivable term also for the performance of those and that for symmetrical networks as well as for asymmetric ones. (auth)

15374 RETENTION OF INERT GASES ION IMPLANTED INTO TRANSPORT TAPES FOR ON-LINE NUCLEAR SPECTROSCOPY. Santry, D. C.; Westcott, O. M. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods; 97: No. 3, 471-4(1971).

Ion implantation of inert gases at low doses into plastic base tapes results in poor collection efficiency. Retention measurements have shown that an instantaneous release of the inert gases occurred during the implantation process and that maximum collection efficiency was obtained using aluminum tapes. (auth)

15375 CONTRIBUTION TO THE ELEMENTARY INTEGRATION OF NONLINEAR TRANSPORT EQUATIONS IN ISOTOPE SEPARATION. PART II. Zieger, K. (Zentralinstitut fuer Isotopen- und Strahlentechnik, Leipzig). Isotopenpraxis; 7: No. 8, 344-8(Aug 1971). (In German).

The elementary integration of a special boundary and initial value problem to the standard version of Cohen's partial differential equations is presented. This mathematical model is related

primarily to the separation of a binary isotope mixture in a countercurrent column with constant cross section that is closed on both sides. (auth)

15376 PROPOSED NEW METHOD FOR SEPARATING ISOTOPES. Stangeby, P. C.; Allen, J. E. (Oxford Univ.). Nature (London); 233: No. 5320, 472-3(15 Oct 1971).

Reference is made to the paper presented by the authors at the Tenth Gas Ionization Conference, Oxford, 1971, on the characteristics of a double mercury discharge vessel in which a large current in the outer vessel irradiated a small discharge current in the inner vessel with 2537 Å resonance radiation. It is suggested that such a double discharge might form the basis of an isotope separator if the outer irradiating discharge were run in a pure isotope and the hyperfine components of the resonance line are separate, and it is shown that ^{200}Hg and ^{202}Hg could be separated in this way. Only the isotope in the inner discharge corresponding to that in the outer will be excited, and the Hg ions accelerated to the discharge wall by a radial electric field will be predominantly of one isotope. The method differs from other methods in current use in that it does not depend directly on the isotopic mass ratios, which for heavy elements are almost unity. Addition of a few mtorr of N_2 to the Hg facilitates the process, and CO should be even more effective. Extension of the method to other elements is briefly discussed. (UK)

15377 ROTOR FOR AN ISOTOPE ULTRACENTRIFUGE. Poubeau, Pierre (to Nord-Aviation Societe Nationale de Constructions Aeronautiques). French Patent 2,058,456. 3 May 1971. Filed 5 Sep 1969. (In French).

A rotor for an ultracentrifuge intended for isotope separation (such as the separation of ^{235}U from ^{238}U in the UF_6 state) is presented. It consists essentially of two cylinders constructed of a high resistance wire material which is externally wound about a rigid framework. These cylinders are longitudinally joined by bracketing distributed around the periphery; these girders constitute the rigid framework about which the wire material is wound. The winding, which is accomplished under prestressed conditions is such that at high rotational speeds the bracketing exerts only a compressional force on the outer cylinder and does not exert any force on the inner cylinder. (France)

15378 VACUUM ENCLOSURE OF THE ELECTROMAGNETIC ISOTOPE SEPARATOR MEIRA. Levy, I.; Chavet, I. (Israel Atomic Energy Commission, Yavne). Vacuum; 21: No. 8, 325-9(Aug 1971).

A short survey is given of the main requirements to be fulfilled by the different vacuum enclosure components according to their function in the separator. The methods and materials chosen for the construction of this enclosure are explained and details of its major components described. (auth)

15379 ENRICHMENT OF URANIUM. Leduc, Ch. (CEA, Paris). Kerntech. Atomprax.; 13: No. 11, 496-8(Nov 1971).

The French research and development program for U enrichment is reviewed starting with studies in 1954 which led to the construction of the Pierrelatte gaseous diffusion facility for military purposes which became operative in 1967. The facility is working satisfactorily with an operational availability over 98%. Consideration of U enrichment for civil purposes began in 1965. First tests on a complete stage configuration for a small scale pilot plant took place in early 1970. A building for testing compressors and stages of a large scale pilot plant has been erected, and significant test results are expected in 1972. A brief reference is made to extensive research on processes other than gaseous diffusion, in particular, the gas centrifuge process. (L.C.L.)

15380 CANTED MAGNETIC FIELD FOR CALUTRON ION SOURCE. Bell, William A. Jr.; Veach, Allen M. (to United States Atomic Energy Commission). U. S. Patent 3,610,923. 5 Oct 1971. Filed 17 Dec 1969.

In a calutron-type ion source, enhanced ion production and extraction are accomplished by orienting the ionizing electron beam in a nonparallel relationship to the arc slit from which the ions are extracted. This may be accomplished by canting the ion source a few degrees with respect to the magnetic field that confines the ionized beam or, preferably, by positioning the ion source conventionally and canting the magnetic field with respect to it. (Official Gazette)

Isotopic Power Sources

Refer also to abstracts 15073, 15074, 15093–15095, 15111, 15141, 15575, 15653, and 17084.

15381 (BRH/DEP–71-5) ELECTROMAGNETIC RADIATION INTERFERENCE WITH CARDIAC PACEMAKERS. Ruggera, Paul S.; Elder, Robert L. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products). Apr 1971. 31p. GPO $0.45.

A study was initiated to determine the relative danger presented to cardiac pacemaker patients by the microwave oven in comparison with other known sources of electromagnetic interference. This report explains how pacemakers and microwave ovens function, describes the mechanism of electromagnetic interference, and outlines the status of the U. S. Public Health Service Division of Electronic Products activities in this area. (auth)

15382 (NUMEC–3057-7) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM. PHASE II. Quarterly Progress Report, August 1, 1971–October 31, 1971. (ARCO Nuclear Co., Leechburg, Pa.). Contract AT(11-1)-3057. 41p. Dep. NTIS.

Development preparations for pilot production of radioisotope-fueled cardiac pacemakers continued. Two Phase I electronic circuits failed in life tests. Fifty Phase II circuits were completed and are undergoing life tests with 4.69 unit years of operation accumulated to date with no circuit failures. Long-term vibration testing and leak testing of nuclear batteries continued. Six nuclear batteries were assembled using materials and methods intended for pilot production. The performance of these units was significantly better than predicted. The cremation testing equipment and procedures are described. (L.C.L.)

15383 (SC-RR–710118) VAPORIZATION OF RADIOISOTOPE FUELS IN LAUNCH VEHICLE ABORT FIRES. Williams, David C. (Sandia Labs., Albuquerque, N. Mex.). Dec 1971. 128p. Dep. NTIS.

Models are developed for estimating the extent to which radioisotopic fuel forms will vaporize if released to the fires resulting from the catastrophic aborts of rocket booster vehicles. Pad aborts of both liquid and solid-propellant systems are considered, and aborts after lift-off are also treated. Estimates are given for the size and activity spectra of the radioactive particles produced when the vapor recondenses. Numerical results are specifically calculated for certain $^{238}PuO_2$ fuel forms (microspheres, solid-solution cermet, and plutonia-molybdenum cermet), but the models themselves should also be applicable to other refractory actinide oxides. The uncertainties involved in the analyses are discussed in some detail. Out of necessity, many simplifications and mathematical approximations were made in the models employed. However, the quite likely do not result in as much error as do the uncertainties in some of the necessary input data concerning fuel-form properties and abort environment characteristics. (auth)

15384 RADIOISOTOPE FUEL CAPSULE. Princiotta, Frank T.; Barr, Harold N. (to United States Atomic Energy Commission). U. S. Patent 3,621,261. 16 Nov 1971. Filed 4 Apr 1969.

A radioisotope fuel capsule is described that has a radioisotope heat source encapsulated by a bimodal thermal insulator comprising a porous insulating layer with a material of higher thermal conductivity and lower melting point than the porous insulating layer disposed in the insulating layer. (Official Gazette)

Radiation Sources

Refer also to abstracts 14757, 14761, and 15574.

15385 (CONF-680423–, pp 17-20) DESIGN OF THE RADIOISOTOPE CENTER. Del Rosario C., Rosa Bertha (Junta de Control de Energia Atomica, Lima (Peru)). (In Spanish).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The Peru Radioisotope Center was designed for the importation and distribution of isotopes for medical purposes and for the preparation of labeled molecules. ^{131}I is the most frequently used isotope. The preparation of labeled compounds has centered on the labeling of albumin and oleic acid. (J.S.R.)

15386 LIGHTNING CONDUCTOR. (to Centre d'Etude de l'Energie Nucleaire en Abrege CEN). British Patent 1,255,569. 1 Dec 1971. Priority date 15 Apr 1969, Belgium.

The lightning rod described consists of a pointed rod and a radioactive source of beta radiation supported by the rod and close enough to the pointed end to produce appreciate ionization at the pointed end. The radiation source is chemically-inert ^{85}Kr. The lightning rod is claimed to be more efficient for lightning protection and radiologically safer to use than similar rods which use solid radiation sources. (L.C.L.)

15387 SYSTEM FOR CONTROLLING RADIO-ACTIVE EMISSIONS INTO A FLUID MEDIUM. Clark, James. British Patent 1,258,407. 30 Dec 1971. Priority date 11 Dec 1967, United States.

A system is described for controlling the magnitude and excitation energy level of radioactive emissions from the surface of a solid body bearing radioactive material and subject to contact with a fluid medium. A particular application of the system is in reducing skin friction of aerodynamic bodies moving through a fluid medium. (J.R.D.)

15388 ALLOWANCE FOR THE INFLUENCE OF RADIOACTIVE IMPURITIES IN THE CHECKING OF GAMMA SOURCES. Karavaev, F. M.; Drichko, A. F. Meas. Tech. (USSR) (Engl. Transl.); 14: No. 5, 761-4(May 1971).

Translated from Izmer. Tekh.; 14: No. 5, 61-3(May 1971).

It is noted that for standard gamma sources of all classes the activity of the nuclide in the source and the exposure dose rate may be measured by a relative technique involving comparison of the ionizing effect of the gamma radiation with a similar source of a higher class. Results of comparison of two gamma sources composed of the same basic nuclide and containing N-1 impurity nuclides not genetically related to the principal one are presented. Results of the investigation are applied to ^{137}Cs sources. It is concluded that in calibration of ^{137}Cs standard sources of the first and second classes, permissible values of the relative limiting error which occur in determining the activity of the ^{134}Cs equal to 10 and 15% respectively must be accepted. (J.R.D.)

15389 RADIATSIONNAYA TEKHNIKA. VYPUSK 5. (Radiation Technology. Number 5). Remizova, R. V. (ed.). Moscow; Atomizdat (1970). 376p.

This collection of 53 separate articles deals with a wide variety of topics which stem from the general subject of radiation technology. The use of the Monte Carlo method for calculating the passage of charged particles through matter and the efficiency of spherical beta sources is explained. Advances are described in the fields of spectral characteristics of neutron sources, various applications of neutron activation analysis (including automation), the measurement of coating thicknesses with radiation, and alpha-beta calorimeters. Specialized radiation equipment design and operation are reviewed. (K.S.W.)

15390 ^{252}Cf PROGRESS. Californium-252 Progr.; No. 10, 1-65(Jan 1972).

ACTIVATION ANALYSIS—neutron sources for, evaluation of californium-252
CALIFORNIUM-252—availability of wire of
—uses of, program for development of industrial and medical
—sales of
—neutron spectra of, preliminary measurements of
—dose from radiotherapy source of
—neutron sources of, comparison with reactors
—shipping and storage of, design of container for
CONTAMINATION—control in soils and waters using californium-252 neutron
INSTRUMENTS—neutron sources for radiometric, evaluation of californium-252
IRRADIATION FACILITIES—neutron sources for, evaluation of californium-252
NEUTRON SOURCES—shielding of californium-252, dose rates for
—development of californium-252, review on
PROCESS EQUIPMENT—control of industrial, using californium-252 neutron sources
PROSPECTING—neutron sources for, evaluation of californium-252
RADIOGRAPHY, INDUSTRIAL—neutron sources for, evaluation of californium-252
RADIOTHERAPY—neutron sources for, evaluation of californium-252
SHIELDED CONTAINERS—design for shipping and storage of californium-252
WELL LOGGING—neutron sources for, evaluation of californium-252 (R.C.K.)

Design and Fabrication

15391 METHOD OF OPERATING A RADIOISOTOPE RADIATION SOURCE. Flaherty, Robert (to United States Atomic Energy Commission). U. S. Patent 3,620,917. 16 Nov 1971. Filed 7 Nov 1969.

A method is described for conserving radioisotopic fuel such as cobalt-60 comprising initially loading a radiation source with a plurality of fuel elements wherein the outputs of the elements are of a decreasing succession with each element decaying to the original power output of a succeeding element in a uniform time interval. After each uniform time interval the least powerful element is replaced with an element having the same output as the original most powerful element. The replaced element is reprocessed by separating the decay products such as nickel-60 from the radioisotopic fuel. (Official Gazette)

15392 METHOD OF FORMING A PATTERNED RADIATION SOURCE. Figueroa, Carlos G. (to Industrial Nucleonics Corp.). U. S. Patent 3,620,794. 16 Nov 1971. Filed 30 Jun 1967.

Precisely patterned radiation sources are formed by exposing a base member to an inert gas radioisotope (krypton-85) at an elevated temperature and pressure to cause interstitial penetration of the atoms of the radioisotope into the lattice of the base material as controlled by a pattern formed on the surface of the base. Another procedure involved uniformly diffusing the atoms of the inert gas radioisotope into the lattice of a base material and subsequently etching portions of the surface to provide a precisely patterned radiation source. (Official Gazette)

Industrial Uses

Refer also to abstracts 14972, 15224, 15398, and 15435.

15393 (LBL-511) MODIFIED AND COMPLETED 1π CLINOSTAT-IRRADIATION SYSTEM. Silver, Ira Lee (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1971. Contract W-7405-eng-48. 25p. Dep. NTIS.

A clinostat-irradiator complex has been designed and built at the Lawrence Berkeley Laboratory. The purpose of these instruments is to study radiation effects on small organisms while they exist under various degrees of gravity compensation. The integrated, experimental system is described. (auth)

15394 (ORNL-IIC-29) RADIOISOTOPES AND RADIATION IN THE TEXTILE INDUSTRY. Miller, F. J.; Baker, P. S. (Oak Ridge National Lab., Tenn.). Feb 1972. Contract W-7405-eng-26. 47p. Dep. NTIS.

The various uses of radioisotopes in the textile industry are surveyed in depth. The topics discussed are gaging, tracer uses, radiation treatment, apparatus, static elimination, soil removal, pest eradication, and some miscellaneous applications. Each major use is discussed in a separate section with its own bibliographic references. Insofar as feasible, all references are checked, using the library facilities of Oak Ridge National Laboratory, Oak Ridge Associated Universities, and the University of Tennessee. Occasionally, however, the cited material is not available; such cases are identified by an asterisk (*). Much of the discussion is limited to coverage of research reports and proposed uses of radioisotopes since there is but little actual use of isotopic methods in the textile industry. The apathetic attitude of the textile industry toward actual application of isotopic methods is indicative of the need for some renewal of impetus. (auth)

15395 METHOD FOR IRRADIATING FOODSTUFFS AND OTHER CONSUMABLES, PHARMACEUTICALS, MEDICAL REQUIREMENTS AND THE LIKE, AND PACKAGING FOR PERFORMING THE METHOD. Brunner, A. (to Sulzer Brothers Ltd.). Canadian Patent 882,959. 12 Oct 1971. Priority date 5 Dec 1968, Switzerland.

The material to be irradiated is packaged in a gas-tight covering before treatment with gamma radiation, then the gases in the interior are brought in contact with substances capable of physically or chemically binding oxygen. Suitable substances for binding the oxygen are silica gel and bentonite. Other arrangements for removing the oxygen inside the package are described. (F.S.A.) (Canada)

15396 RIGID POLYTHENE CONTAINERS FOR THE RADIATION STERILIZATION OF SUPPLIES FOR GERM-FREE ANIMAL ISOLATORS. Cook, R. (Allington Farm, Salisbury, Eng.); Crook, L. J. Lab. Anim.; 5: No. 2, 213-19(1971).

Commercially available, low-density polyethylene containers were modified so that any 2 of them fitted into a standard cardboard carton suitable for the irradiation plant in this country. Each container was filled with supplies to a total weight of 9.3 kg and, after sterilization by gamma irradiation, was attached to the transfer port of a germ-free isolator. The adoption of these airtight containers shortened the time spent on packaging and large quantities of diet and other supplies could be passed into isolators at single entries, thus reducing the frequency of entry. The attached containers could also be used for the removal of waste materials. (auth)

15397 MODULAR ELECTRON SOURCE FOR UNIFORMLY IRRADIATING THE SURFACE OF A PRODUCT. Skillicorn, Brian (to High Voltage Engineering Corp.). U. S. Patent 3,617,740. 2 Nov 1971. Filed 8 Oct 1968.

A device is described for irradiation of coatings and similar ma-

terials having a relatively large surface of complex shape to be irradiated. The invention employs a modular construction in which each module comprises a relatively small and independently movable electron accelerator which is complete but for the provision of the accelerating voltage. In general, apparatus has a common insulating housing and a common voltage source. In the housing are mounted independently movable electron accelerators. A multiplicity of these accelerators is arranged so as to provide a wide array of generally parallel electron beams which are positioned so as to overlap at the surface of the product to be irradiated. Depending upon the nature of the surface, the electron beams may or may not be actually parallel, the purpose being to insure that each electron beam impinges on the surface to be irradiated normal thereto. (Official Gazette)

LIFE SCIENCES

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 14890, 14951, 15401, 15475, 15482, and 15483.

15398 (IAEA-R-490-F) RADIATION RESISTANCE OF CATHEPSINS OF VARYING PURITY. PART OF A COORDINATED PROGRAMME OF RESEARCH IN THE ASPECTS OF TISSUE PHYSIOLOGY IN FOOD PRESERVATION BY IRRADIATION. Final Report, January 15, 1967–March 31, 1971. Siebert, G. (International Atomic Energy Agency, Vienna (Austria)). Mar 1971. 32p. INIS.

The storage life of fresh fish may be extended by treatment with relatively low doses of ionizing radiation (ca. 100 Krad). The reduction of microbial counts thus achieved is not accompanied by the inactivation of the enzymes found in fish muscle. This paper reports on the degree and mechanism, both radiochemical and enzymological, of the inactivation of proteolytic enzymes from the muscle tissue of irradiated cod, redfish, coalfish, and haddock. Irradiations were performed in the Varian linear accelerator of the Institute of Radiation Technology, Federal Laboratory for Food Preservation, Karlsruhe. Differentiation and separation of two catheptic components from cod muscle are described. Differentiation is based mainly on reaction towards ion exchange, molecular weights and kinetic differences. Muscle tissue from the four species of fish required 10 to 20 Mrad for a partial inactivation of cathepsin. After extraction, cathepsin becomes several times more sensitive. The ED_{37} for different dipeptidases from four species of fish was found to be between 3 and 5 Mrad in situ and between 0.2 and 0.4 Mrad in raw extracts. (INIS)

15399 (ORO-3630-13) PHOTOREPAIR OF UV DAMAGE TO DNA PURIFICATION AND PROPERTIES OF THE DNA PHOTOLYASE (THE DNA-PHOTOREACTIVATING ENZYME). Progress Report, January 2, 1971–January 2, 1972. Werbin, Harold (Texas Univ., Dallas). Contract AT(1-40)-3630. 27p. Dep. NTIS.

There is associated with the DNA-photolyase purified by affinity chromatography substances that have the spectral properties expected for the chromophore involved in DNA-photoreactivation. These substances can be dialyzed in part away from the enzyme when it is concentrated in a collodion membrane. The fluorescence of the dialyzate is similar to that of the enzyme except for a blue-shift in the maxima of excitation and fluorescence emission. Two yellow green materials whose spectral properties mimicked those of known pteridines were separated from the dialyzate by paper chromatography. Heating the enzyme induces this blue-shift but addition of substrate, irradiated DNA, retards it. These data implicate the fluorescent substances bound to the enzyme as the actual photosensitizers in DNA photoreactivation. By assuming that the large loss in activity observed when the enzyme was purified by affinity chromatography was due to loss of the bound chromophore, we could use this enzyme preparation to bioassay for chromophore in crude yeast and algal extracts. Both were active and after each was subjected to paper chromatography two diffuse bands that assayed positively were observed. Nevertheless, these substances are designated as activators since there is not unequivocal evidence that they are actually the chromophores for DNA-photoreactivation. (auth)

15400 RADIATION EFFECTS IN GLYCOPROTEINS AND RELATED CARBOHYDRATES. Cavatorta, P.; Crippa, P. P.; Vecli, A. (Univ., Parma, Italy). Int. J. Radiat. Phys. Chem.: 3: No. 41, 483-90(Dec 1971).

In order to determine the possible influence of prosthetic groups on the radiation effects in glycoproteins, the radical yield of a group of such molecules and related carbohydrates was determined by the ESR technique. The results indicate the absence of any measurable radiation protection of the prosthetic groups. Some inferences on the nature of radicals induced both in proteins and in carbohydrates examined are also reported. (UK)

15401 6,7-DIMETHOXYCOUMARIN IN THE PEEL OF GAMMA-IRRADIATED GRAPEFRUIT. Riov, J. (Hebrew Univ., Rehovot, Israel). Phytochemistry; 10: 1923(1971).

6,7-Dimethoxycoumarin was isolated from the peel of γ-irradiated mature grapefruit. It accumulates in fruits irradiated with relatively high doses (300 and 400 krads) and is absent from non-irradiated fruits. (auth)

15402 IN VITRO EXCISION-REPAIR OF ULTRAVIOLET-IRRADIATED TRANSFORMING DNA FROM BACILLUS SUBTILIS. Heijneker, H. L.; Pannekoek, H.; Oosterbaan, R. A.; (and others) (Medical Biological Lab. TNO, Rijswijk, Netherlands. Univ., Groningen, Netherlands). Proc. Nat. Acad. Sci. U. S. A.; 68: No. 12, 2967-71(Dec 1971).

The biological activity of uv-inactivated Bacillus subtilis DNA is partly restored after incubation with a uv-specific endonuclease from Micrococcus luteus in conjunction with DNA polymerase and DNA ligase, both isolated from Escherichia coli. The restored activity is not further increased by photoreactivation. Pyrimidine dimers are specifically liberated when irradiated DNA is exposed to the three enzymes. None of these effects is observed when pancreatic DNase is used instead of uv-specific endonuclease. (auth)

15403 INFLUENCE OF HYDROPHOBIC INTERACTIONS AND HYDRATION ON THE RADIOSENSITIVITY OF A PROTEIN. Rosen, Carl-Gustaf (Univ. of Stockholm). Acta Chem. Scand.; 25: 1472-4(1971).

Bovine serum albumin and several conjugates with specified water contents were irradiated in a ^{60}Co source. It appears that the radiosensitivity of a protein may be reduced by the adsorption of water and of compounds binding to hydrophobic regions. (Denmark)

15404 MODIFICATION OF REGULATORY AND CATALYTIC PROPERTIES OF PHOSPHORYLASE-b BY IRRADIATION AND HEAT. Damjanovich, S.; Csecsei, Gy.; Suemegi, J. (Medical University School, Debrecen, Hungary). Acta Biochim. Biophys (Budapest); 6: No. 3, 251-7(1971).

The separate and combined effects of temperature and ^{60}Co γ irradiation were studied on highly purified glycogen phosphorylase-b (α-1,4-glucan: orthophosphate glucosyltransferase, EC 2.4.1.1). The enzyme activity is more sensitive to the allosteric effector than to the substrate between 30 and 44.5°C. There is an opposite effect between 10 and 30°C. The irradiated phosphorylase-b changed its affinity to the substrate and to the allosteric activator in different manners between 15 and 44.5°C. In accordance with the Arrhenius plot, irradiation decreased the stability of the enzyme at elevated temperatures. The findings suggest that irradiation enhances the temperature sensitivity of the catalytic and allosteric sites separately. (auth)

15405 ENERGY REQUIREMENTS FOR THE INACTIVATION OF RIBONUCLEASE A BY SLOW ELECTRONS. Saito, Masahiro; Maki, Hirotoshi. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 4: 49-55(1971).

Ribonuclease A from bovine pancreas was irradiated with very slow electrons (5 to 30 eV) in the dry state. The analysis of dose effect curve revealed that in this energy region the efficiency of inactivation of this enzyme does not depend on electron energy and 2 to 3 molecules are inactivated by one incident electron. These observations are discussed from view points of the localization of energy deposition and intermolecular energy transfer in condensed molecule layers. (auth)

15406 REACTION OF OXYGEN DURING IRRADIATION OF PROTEIN. Pavlovskaya, T. E.; Kharchenko, L. I. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 2, 481-4(11 Sep 1971). (In Russian).

Human serum albumin was exposed to ^{60}Co gamma radiation at 100, 200, and 370 R/sec in the presence of pure oxygen that was enriched with ^{18}O. Protein samples were ignited at 530°C for 3 hr, and the ^{18}O in the resulting CO_2 was determined with an accuracy of ±2% with a mass spectrometer. The ^{18}O content of the CO_2 samples varied as the dose of radiation given the protein samples. (K.S.W.)

15407 EFFECT OF GAMMA-IRRADIATED SUGARS ON THE GROWTH AND DEVELOPMENT OF PLANT TISSUE CULTURES. Bajaj, Y. P. S. (Michigan State Univ., East Lansing). Z. Pflanzenphysiol.; 65: No. 5, 418-26(1971).

The effect of ^{60}Co gamma-irradiated sugars on the growth and development of callus tissue cultures, excised roots, ovules and embryos of Glycine max, Nicotiana tabacum, Pelargonium hortorum and Phaseolus vulgaris has been studied. The growth responses, color, texture and friability of the callus tissue were strongly influenced by gamma-irradiated (2 Megarad) sucrose, glucose and fructose. These cultures showed growth inhibition up to 67%, were darker in color, harder in texture and less friable. The irradiated glucose medium also inhibited the growth of excised roots of Glycine max, however, this growth inhibition was

markedly reduced if the roots were grown on an irradiated glucose medium stored for six months. The growth of immature ovules and embryos of Nicotiana tabacum and Phaseolus vulgaris respectively, was inhibited considerably on the irradiated sucrose medium. The inhibition was more pronounced if the embryos were excised and cultured at early stages of development. (auth)

15408 PHYSICAL AND CHEMICAL CHANGES IN SOLUTIONS OF HEN EGG WHITE LYSOZYME INDUCED BY IONIZING RADIATION. Ragatz, Barth Henry. Bloomington, Ind.; Indiana Univ. (1971). 192p. University Microfilms Order No. 71-29,586.

Thesis.

Solutions of hen egg white lysozyme were exposed to irradiation and the kinds of chemical and conformational damage that occur to this protein were investigated. The alteration of tryptophan residues represented the principal type of amino acid modification caused by such treatment. Although various secondary bonding modes were disturbed by this treatment, as indicated by tyrosine exposure, increased trypsin susceptibility and facilitated thermal denaturation, the secondary structural features were preserved. This was demonstrated by the pH-activity profiles remaining similar to that of native lysozyme and by the apparent stability of the four disulfide bridges that are present in the molecule. There was no substantial tendency of the lysozyme molecules to aggregate since no rapidly sedimenting material was detected by analytical ultracentrifugation. A single new N-terminus (alanine) was found by dinitrophenylation, followed by acidic hydrolysis and thin layer chromatography. This suggested that sensitive regions within the molecule were only important by this criterion at the highest radiation dose employed (50,000 R). Irradiated material subjected to gel filtration chromatography revealed only two major fractions of protein species. The material initially eluted from the column gradually increased in amount as radiation dose was increased, and it was without enzymatic activity. The other fraction decreased as radiation dose increased and was most like native lysozyme. Attempts to select compounds that might be radioprotective of lysozyme solutions by the possibility of tryptophan protection were successful. Tryptophan analogs and metabolites were useful for this purpose since they may be effective free radical scavengers. Certain iodinated dyes and biological molecules were also protective. (Diss. Abstr. Int., B.)

15409 PHYSIOLOGICALLY-INDUCED CHANGES IN THE REPAIR OF GAMMA-RAY-INDUCED SINGLE-STRAND BREAKS IN ESCHERICHIA COLI Ki2. Grdina, David John. Lawrence, Kan.; Univ. of Kansas (1971). 71p. University Microfilms Order No. 71-27,149.

Thesis.

Strains of Escherichia coli K-12 which are genetically rec^+-lex^+ have a resistance to gamma-rays when they are grown to the stationary-phase in a glucose-enriched nutrient broth (GNB) which is greater than that observed for these strains grown in nutrient broth (NB). Cells which are rec^- or lex^- do not exhibit this glucose-induced resistance (GIR). The investigation was undertaken to elucidate the relationship between these genetic loci and the phenomenon of GIR. In particular, studies were performed to observe the relationship between GIR and the repair of single-strand breaks induced in the DNA of cells exposed to gamma-irradiation. An attempt was made to correlate the repair of this damage with cell survival. The technique of alkaline sucrose gradient centrifugation was used to study single-stranded DNA labeled with tritiated thymidine. DNA was extracted from cells which were exposed to 20 krads of gamma-irradiation and held in a post-irradiation nutrient medium for various periods of time. Sedimentation profiles were obtained by plotting the per cent of the recovered activity versus the distance from the meniscus traveled by the labeled material. The sedimentation rate of DNA from irradiated cells incubated in a post-irradiation nutrient medium increased with time as the repair of single-strand breaks was accomplished. For the given dose of gamma-rays the yield of single-strand breaks appeared to be independent of either the strain or the two conditions of growth. The GNB-grown rec^+ cells rejoined a greater number of gamma-ray induced single-strand breaks than did NB-grown cells. The rec^- strains tested showed no such difference. Cells which were lex^- exhibited a high degree of DNA degradation. While the growth in GNB did accelerate the repair of some single-strand breaks, the degradative processes present more than compensated for any advantageous effect and rendered the cells highly radiation-sensitive. The results obtained demonstrated that the increase in radiation-resistance of the rec^+ cells grown in GNB could be correlated with an increase in the amount of repair of single-strand breaks or alkali-labile bonds. These results suggested that single-strand breaks, while being lethal unless repaired, must also be repaired within a critical period of time during post-irradiation incubation in a nutrient medium. While the repair of this damage is necessary for survival, the lack of repair of other potentially lethal damage remaining in the genome would lead to eventual cell death. In conclusion, the greater amount of repair of single-strand breaks in rec^+ cells grown in GNB appears to be responsible for their enhanced survival. (Diss. Abstr.)

15410 INFLUENCE OF pH AND CONCENTRATION ON THE GAMMA-RADIATION INDUCED THIOBARBITURIC-ACID-REACTING-SUBSTANCES (TBRS) IN GLUCOSE AND SUCROSE SOLUTIONS. Upadhya, Mahesh D.; Brewbaker, James I. (Univ. of Hawaii, Honolulu). Contract AT(04-3)-235. Curr. Sci. (India); 41: No. 1, 25-7(5 Jan 1972).

Studies were made on the quantity of thiobarbituric acid-reacting substances formed in aqueous solutions of glucose and sucrose subjected to γ radiation at dose levels of 50 to 100 krad. The yield of these substances was higher in sucrose than in glucose solutions, although there was a general increase in values with increasing dose and increasing pH. (M.C.G.)

Radiation Effects on Cultured Cells (External Source)

Refer also to abstracts 15447 and 15474.

15411 (COO-3110-2) CELLULAR HEREDITY IN HAPLOID CULTURES OF SOMATIC CELLS. Annual Progress Report, December 1970-November 1971. Freed, Jerome J. (Institute for Cancer Research, Philadelphia, Pa.). 1 Dec 1971. Contract AT(11-1)-3110. 16p. Dep. NTIS.

Properties of haploid frog cell strains in culture were studied. Primary cultures were initiated from tail bud haploid embryos that developed from fertilized eggs from which the maternal pronucleus was removed with a glass needle. The chromosomes of the cells are described and a figure showing the idiogram is presented. Effects of x radiation on survival of cells were investigated to determine whether multiplicity of gene loci affects survival since it had been observed that heteroploid mammalian cell lines showed a more complex survival curve. Other experiments were conducted to study resistance of haploid cells to puromycin and BUdR. Studies on ^{3}H-thymidine uptake into wild type and BUdR resistant haploid cell strains were conducted and results are shown by means of a graph. Ultrastructures in cell motility were investigated using electron microscopy and the role of microtubules in the behavior of cultured cells is discussed. Tritiated thymidine was used in investigations on conditions for the induction, selection, and characterization of cold-sensitive lethal variants. (H.L.W.)

15412 (ORO-3646-14) COMPARATIVE STUDY OF RADIATION, CHEMICAL, AND AGING EFFECTS OF VIRAL TRANSFORMATION. Annual Progress Report. Coggin, Joseph H. Jr. (Tennessee Univ., Knoxville. Dept. of Microbiology). 29 Dec 1971. Contract AT(40-1)-3646. 20p. Dep. NTIS.

Investigations were conducted on basic mechanisms and conditions that result in the conversion of normal cells to malignant or neoplastic cells following infection with oncogenic viruses. Effects of x radiation on the transforming efficiency of SV40 virus in hamster embryo cells were studied. When cells were aged or exposed to x radiation or 5-IUDR, growth and DNA replication were impaired. Unusual numbers of chromosome breaks or lesions occurred when cells were cultured in vitro. These observations indicated that chromosome damage markedly sensitized the normal cell population to an interaction with the virus resulting in enhanced fixation of the transforming event and transition of the cell to the malignant state. (H.L.W.)

15413 RADIOSENSITIVITY OF MELANOMA CELLS IN CULTURE. Dewey, D. L. (Mount Vernon Hospital, Middlesex, Eng.). Brit. J. Radiol.; 44: No. 526, 816(Oct 1971).

The survival of murine melanoma cells growing in single-cell culture after irradiation by 250 kV x rays with doses of 0 to 800 rad was measured. The results showed no evidence of intrinsic radiation resistance. (UK)

15414 POSSIBLE EFFECTS OF DOSE RATE AND TURNOVER TIME OF CELLS ON DOSE-RESPONSE RELATIONSHIPS: IMPLICATIONS FOR RADIATION PROTECTION GUIDANCE. Walsh, Phillip J. (Dept. of Health, Education, and Welfare, Research Triangle Park, N. C.). Int. J. Environ. Stud.; 2: 189-93(1971).

A qualitative appraisal was made of the effects of radiation dose rate and turnover time of exposed cell populations on dose-

response relationships. On the basis of the direct and simple treatment given, dose-response relationships are governed by dose-rate as related to the rate of turnover of exposed cells. Dose-response relationships for cells in culture and those functioning in the body are discussed and some differences are pointed out. For purposes of radiation protection, the assumption of a linear dose-response relationship is supported. The processes of cell death and alteration as related to dose and turnover time of cells are discussed as factors of prime importance in experimental design and in the medical treatment of abnormal cells. (auth) (UK)

15415 ENHANCEMENT OF X-RAY DAMAGE TO CHINESE HAMSTER CELLS BY HYPERTONIC TREATMENTS. Dettor, Charles Mallory. Fort Collins, Colo.; Colorado State Univ. (1971). 113p. University Microfilms Order No. 71-30,059.

Thesis.

The effect of hypertonic treatment on radiation survival was studied in Chinese hamster ovary (CHO) cells. Cells were treated with medium containing 5% myo-inositol in conjunction with x irradiation. This treatment increased the radiosensitivity of the cells, yet had no toxic effect on unirradiated cells. The radiosensitizing effect was most pronounced in S phase cells, and in these cells it was found that myo-inositol inhibits the repair of potentially lethal damage in addition to causing an increase in initial radiation damage. The myo-inositol need not be present in the medium at the time of irradiation, since it had a residual effect when removed before irradiation and also a radiosensitizing effect when added after irradiation. When S phase cells were treated with myo-inositol and irradiated at 37C, confirmation of damage was extremely rapid, and the survival end point was ten times lower than that of the same treatment at 20C. The kinetics of all these effects were investigated. In addition to the survival parameters noted, the hypertonic medium rapidly reduced both cell and nuclear size and depressed the synthesis of DNA, RNA, and protein during the cell cycle. Survival of S phase cells and size changes during the cycle were evaluated with other hypertonic media containing NaCl, KCl, sorbitol, or glucose. Results of these experiments were similar to those found with myo-inositol. At the ultrastructural level, the chromatin of S phase cells treated with myo-inositol was condensed, appearing like that of mitotic cells. The condensation was reversible when the treated cells were placed back in isotonic medium. Nucleoli of these cells placed in the 5% myo-inositol appeared uniformly granular, and on returning the cells to isotonic medium, the normal pattern of fibrous and granular material reappeared. Myo-inositol sensitized S phase cells, but did not sensitize mitotic cells in which the chromatin was already condensed. These relationships led to the development of a model in which radiosensitization and the inhibition of repair was discussed in relation to all the phenomena observed. Based on the experimental evidence and other investigators' work concerning chromatin condensation, it was concluded that chromatin condensation effected by the hypertonic treatment was the most likely cause for the increased radiosensitization and the inhibition of repair. (Diss. Abstr. Int., B)

15416 ANTIGEN BINDING CELLS. II. EFFECT OF HIGHLY RADIOACTIVE ANTIGEN ON THE IMMUNOLOGIC FUNCTION OF BONE MARROW CELLS. Unanue, E. R. (Harvard Medical School, Boston). J. Immunol.; 107: No. 6, 1663-5(Dec 1971).

Bone marrow cells of non-immune mice were rendered immunologically incompetent by incubation with highly radioactive ^{125}I-labeled hemocyanin. Lethally x irradiated mice that were reconstituted with such bone marrow cells responded poorly to KLH but well to sheep erythrocytes and exhibited a lower number of lymphocytes binding KLH in spleen. These results suggest that some bone marrow cells are already differentiated to respond immunologically to a given antigen. (auth)

15417 RADIOTHERAPEUTICAL APPLICATION OF FAST NEUTRONS AND π^--MESONS. Barendsen, G. W.; Broerse, J. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Atomkernenergie; 18: No. 3, 247-52(Nov 1971).

A review is presented of experimental data with respect to the relative biological effectiveness (RBE) of fast neutrons for induction of cell reproductive death in cells of tumors and various normal tissues. It is demonstrated that dose-effect relations for fast neutrons differ in three aspects from those obtained with x rays, γ rays, or fast electrons. The RBE is generally larger than 1. The effects of fast neutrons depend less on fractionation than those of x rays. The oxygen enhancement ratio for effects produced by fast neutrons is generally smaller by a factor of 1.5 to 1.7 in comparison with x rays. The significance of these differences for the possibilities of applications of fast neutrons or π^- mesons in radiotherapy is demonstrated on the basis of data obtained with tumors and normal tissues in animals. Finally some technical and clinical aspects of the therapeutical applications are mentioned. (auth)

Radiation Effects on Microorganisms (External Source)

15418 (CEA-N-1471) VARIATION IN THE E. COLI K12 POPULATION AFTER UV IRRADIATION. GROWTH OF E. COLI K12 IN A MINERAL MEDIUM. Tremeau, Odile (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1971. 28p. (In French). Dep. NTIS (U. S. Sales Only).

The curve representing the variation in the E. Coli K12 population after uv irradiation can be divided into two parts: the first part corresponds to an increase by a factor of 10 of the number of survivors and occurs immediately after the irradiation; this is probably the ordinary recovery phenomenon; the second part which occurs after a few hours may correspond to an increase by a factor of 10^3 and is probably a growth phenomenon of E. Coli K12 in a mineral medium. This phenomenon is difficult to explain as the bacteria do not find from their reserves the materials required for their multiplication as this growth occurs even when the bacilli have been exhausted in a buffer medium. It must therefore be assumed that sufficient organic material occurs in mineral media to allow the growth of bacteria with few nutritional requirements such as E. Coli K12. (France)

15419 ACID-SOLUBLE DEOXYNUCLEOTIDES AND DNA SYNTHESIS IN GROWING YEAST AFTER X IRRADIATION. I. DIPHENYLAMINE POSITIVE MATERIAL IN SYNCHRONIZED AND ASYNCHRONOUSLY GROWING CELLS. Eckstein, Hans (Univ., Hamburg). Z. Naturforsch., 26b; No. 12, 1266-70 (Dec 1971).

In synchronized growing yeast, the level of acid-soluble purine deoxynucleotides, as determined by the diphenylamine reaction, fluctuates rhythmically: A rapid increase each time before DNA starts to replicate is followed by a considerable decrease during DNA augmentation. Delay of DNA replication by irradiation of synchronized yeast with 50 kr of x rays results in a stepwise augmentation of deoxyribose derivatives. The fluctuating behavior is restored, when DNA starts to increase, again. During asynchronous growth, acid-soluble deoxyribosidic compounds are augmented with a considerably increased rate, when DNA replication is delayed by x rays. The resulting unusual pool size is maintained, even if DNA replication is resumed to a normal degree, but the rate of further increase is reduced to normal values. Parts of the rapidly accumulated deoxyribosidic material differ with some properties from purine deoxynucleotides. (auth)

15420 STUDIES ON THE RECOVERY OF X-IRRADIATED BACTERIA. Mukherjee, P. (Saha Inst. of Nuclear Physics, Calcutta). Z. Naturforsch., 26b; No. 12, 1383-4(Dec 1971).

Protein synthesis in Escherichia coli was arrested by chloramphenicol. When cells grown in media containing chloramphenicol were x-irradiated there was no increase in survival. When the media in which the bacteria were incubated was x-irradiated with small doses, the survival of x-irradiated bacteria increased. When the x-ray dose to the media was increased above 6 krad, recovery of the x-irradiated bacteria was inhibited. Similar results were obtained when the media was treated with ultraviolet radiation. Results of the experiments confirmed previous observations that soluble protein is responsible for recovery. (H.L.W.)

15421 EFFECTS OF IONIZING RADIATION ON BACTERIAL DNA-MEMBRANE COMPLEXES. Cramp, W. A.; Watkins, D. K.; Collins, J. (Hammersmith Hospital, London). Nature (London) New Biol.; 235: No. 55, 76-7(19 Jan 1972).

A complex containing most of the DNA attached to the cell membrane, was isolated from Escherichia coli B/r. Doses of electrons of 50 to 100 krad administered to aerated suspensions increased the extent of new DNA synthesis (measured at room temperature by the uptake of ^{3}H-deoxycytidine). Only after doses greater than 100 krad was a decrease in synthetic activity observed and results were similar under anoxic conditions, and at time lapses of 30 or 60 minutes. When whole cells were irradiated and the DNA-membrane complex isolated later, very much smaller doses were needed to depress synthetic activity, and the extent of the depression depended on the time after irradiation before cell lysis. Maximum effect was seen after 40 min and depression of DNA synthesis could be observed after doses as low as 2 krad in aerobic and 5 krad in anoxic conditions. The maximum depression of total DNA synthesis was reached after 20 krad in aerobic and after 80 krad in anoxic conditions when survival was 2% and 3% respectively. After higher doses the total amount of DNA synthesized began to increase above the point of maximum depression but even after 20 krads, total synthesis was only 80% of that of the DNA-membrane complex from irradiated bacteria. (UK)

15422 DNA ABERRATIONS FOLLOWING IRRADIATION OF RECOMBINATIONLESS (REC A) MUTANTS OF SALMONELLA TYPHIMURIUM. Ferron, William Lee. Manhattan, Kan.; Kansas State Univ. (1971). 122p. University Microfilms Order No. 72-1786.

Thesis.

The question of whether near-UV sensitivity reported for recombinationless mutants is due to small amounts of contaminating far-UV has been resolved; uncontaminated near-UV (above 320 nm) is lethal to these mutants. Far-UV acts directly on the DNA to produce thymine dimers. Although far-UV is absorbed by DNA, near-UV is not. The lack of protection by both thymine and DNA suspensions placed between the lamp and the sample, the lack of DNA degradation following blacklight exposure, and the absence of detectable damage in alkaline sucrose gradients suggest that near-UV does not strike DNA directly. Although the above experiments tend to eliminate DNA as the target molecule for near-UV energy, they do not clarify the nature of this target molecule. The wavelengths responsible for near-UV kill are above 320 nm, extending into the visible range of 425 nm. DNA degradation is proportional to, but not prerequisite for, cells death following far-UV irradiation. Evidently those cells that are destined for death eventually degrade all their DNA. DNA degradation does not occur when cells are exposed to near-UV light above 295 nm. But unfiltered near-UV lamps cause extensive DNA degradation without increasing the rate of lethality. Variation in light emitted by filtered and unfiltered lamps has been analyzed and degradation attributed to a small amount of contaminating far-UV emitted from the unfiltered lamp. Irradiated tryptophan is also capable of stimulating DNA degradation in recA mutants, but its mechanism of action remains unknown. DNA degradation requires both pyrimidine dimer formation and replicating DNA. In the absence of replication, gaps necessary for initiation of degradation are lacking. The lack of lesions in the DNA prevents the attachment of the nuclease to the DNA. Near-UV probably does not produce dimers, but it definitely stops DNA synthesis; therefore, near-UV does not promote degradation. In $recA^+$ cells, degradation is confined to the replication complex following UV damage. In the recA mutant, the nuclease is freed of control and proceeds to degrade DNA completely. It is proposed that $recA^+$ cells regulate DNA degradation by binding the nuclease to the replication complex; this binding may involve a respiratory enzyme. (Diss. Abstr.)

15423 PERMANENT AND TEMPORARY MORPHOLOGICAL CHANGES IN MICRASTERIAS INDUCED BY GAMMA RAYS. Waris, H.; Rouhiainen, I. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A IV; No. 167, 1-13(1971).

The effect on Micrasterias species of gamma rays from a ^{60}Co source was tested in order to find out whether mutations would be induced. Five cases of permanent morphological changes are regarded as mutations; four of them were obtained with M. fimbriata and one with M. torreyi. From all these mutations viable clones have been derived. In M. fimbriata, two mutations of the same kind involved withdrawal of the chloroplast from the sinus edge, leaving either open gaps or enclosed vacuoles between the two. Two other mutations involved widening of the lateral incisions and enlargement of cell size. All these mutations were accompanied by defects in the chloroplasts. It is remarkable that similar mutations resulted from treatments with different doses of gamma rays. Clones of M. torreyi derived from cells treated with different doses now and then produced cells with superimposed lobes, a feature characteristic of polyploidy and hyperhaploidy. From such a cell a clone was derived that maintained this feature permanently and is regarded as implying chromosome mutation. In the other cases the character was temporary. The mutation in M. torreyi is of a kind that can be induced by various means, whereas those in M. fimbriata represent types which are not known to have been produced by treatments other than gamma rays. In M. thomasiana var. notata, a non-permanent change of long duration was induced, involving a reduction of size and differentiation. (auth) (FINLAND)

15424 STUDIES OF THE DEPENDENCE ON ENERGY OF THE BIOLOGICAL EFFECTS OF FAST NEUTRONS. II. SURVIVAL OF SPORES OF ASPERGILLUS NIGER AND FUNARIA HYGROMETRICA AND A MICRODOSIMETRICAL COMPARISON OF THESE EFFECTS IN OTHER PLANT MATERIALS. Hamann, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). Radiat. Bot.; 11: No. 6, 437-46(Dec 1971).

A comparison was made between the biological effects of 3.4-MeV and 14.7-MeV neutrons. The investigated effects were the survival of Aspergillus niger and Funaria hygrometrica spores. The neutrons were produced by the reactions $^2H(d,n)^3He$ and $^3H(d,n)^4He$ using a 600-keV cascade accelerator. The constant reactivity k of the exponential part of the dose effect curves was used as measure of biological effectiveness R(E) (E = neutron energy in MeV). The energy dependence of the neutron effects has been described as the ratio of the effectivenesses for the two neutron energies R(14.7)/R(3.4). The numerical values of this ratio are: 0.63 and 0.35 for the survival of Aspergillus niger and Funaria hygrometrica respectively. These ratios, as well as the ratios R(14.7)/R(gamma), deviate appreciably from the corresponding values for growth inhibition and induction of chromosome aberrations in Hordeum and Vicia faba, reported in previous work. This object dependence can be slightly clarified with very simple suppositions, if the event frequency integrals according to Rossi were applied to microvolumes comparable in size to essential biological structures. (auth) (UK)

Radiation Effects on Plants (External Source)

Refer also to abstracts 15469 and 15519.

15425 (BNL-16333) ENVIRONMENTAL CONDITIONS THAT MODIFY PLANT RESPONSE TO NEUTRON IRRADIATION. Smith, Harold H. (Brookhaven National Lab., Upton, N. Y.). [1971]. 13p. (CONF-711204-1). Dep. NTIS.

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971).

Various environmental factors that influence response to irradiation in both wet and dry plant systems are reviewed. The oxygen effect, expressed quantitatively as the oxygen enhancement ratio (OER), is lower for neutrons (1.3-1.9) than for sparsely ionizing radiations. X and γ rays give OER's of 2.4 to 3.4 in wet systems and 10-15 in very dry seeds (2-3% water content). Water appears to regulate the degree to which radiation induced oxygen-sensitive sites or radicals interact with oxygen to produce radiobiological damage. The effect is less with neutrons than with x irradiation. Control over mutagenic or other specific radiobiological responses may lie, not so much in specific reactions with DNA, but more with cellular processes that precede or follow treatment, so that preferential recovery may take place. Examples are given of some environmental perturbations that show promise for altering response to neutron irradiation. (auth)

15426 (CSIRO-Trans-10640) AMINO-ACID COMPOSITION OF PROTEIN IN RADIATION INDUCED VARIETIES OF LUPIN FOR FODDER AND IN ECONOMICALLY VALUABLE MUTANTS OF SPRING WHEAT. Golovchenko, V. I.; Solonenko, L. P.; Chernyi, I. V.; Khvostova, V. V.; Trofimova, O. S. Translated for Australian Atomic Energy Commission Research Establishment, Lucas Heights, from pp 149-62 of report STI/PUB-258. 20p. (CONF-700612-3). Dep. NTIS (U. S. Sales Only).

An abstract of this paper prepared from the original appeared as NSA 25: 24106 (1971). (Australia)

15427 RADIATION-INDUCED CHROMATID ABERRATIONS IN THE G_1 PHASE OF CREPIS CAPILLARIS CELLS. Dubinin, N. P.; Nemtseva, L. S.; Halikov, P. H. (Inst. of General Genetics, Moscow). Caryologia; 24: No. 1, 117-28(Jan-Mar 1971).

Along with chromosome aberrations, ^{137}Cs gamma irradiation in high doses induces chromatid aberrations in the pre-synthetic phase G_1 of the naturally synchronized cell population of embryonic radicles in Creepis capillaris seeds. This occurs in seeds with an artificially decreased moisture content. The irradiation of dry seeds seems to induce primary chromosome lesions of two qualitatively different types. In addition to usual short-lived potential lesions appearing in G_1 as chromosome rearrangements, long-lived potential lesions that survive till the S phase to be fixed as chromatid aberrations also develop. (auth)

15428 EFFECT OF THE MUTAGENS HYDROXYLAMINE, ETHYL METHANE SULPHONATE, AND GAMMA RAYS SEPARATELY AND IN COMBINATION ON MEIOTIC CHROMOSOMES. Srinivasachar, D.; Mohandas, T. K. (Indian Agricultural Research Inst., New Delhi). Caryologia; 24: No. 1, 1-11(Jan-Mar 1971).

The effects of the mutagens hydroxylamine, ethyl methane sulphonate, and gamma rays separately and in combination were studied on the meiotic chromosomes in the M_1 generation of an inbred strain of Pennisetum typhoides. The significant findings were as follows: When hydroxylamine followed 20 kR gamma ray treatment the quadrivalent frequency was brought down from 22.03 to 1.81%, giving support to the view that hydroxylamine inhibits rejoining and restitution of chomosomal breaks. But when it followed 30 kR gamma ray treatment, the restitution and rejoining frequency increased and the highest frequency of quadrivalents, 34.26% was observed besides 0.92% hexavalents and 2.31% trivalents. Thus, hydroxylamine seemed to act either as an inhibitor or promotor of restitution and rejoining depending

upon the intensity of the ionizing radiation. Ethyl methane sulphonate which attacks the guanine-cytosine base pair, like hydroxylamine, also acts as an inhibitor of restitution and rejoining since it brought down the quadrivalent frequency of 22.03%, produced by 20 kR gamma rays, to 10.66%. Similarly, the quadrivalent frequency induced by 0.6% ethyl methane sulphonate was also reduced from 27.12% to zero by hydroxylamine. (auth) (INIS)

15429 RADIATION-INDUCED DEFORMITIES IN VEGETATIVELY REPRODUCED DUCKWEED. Kasinov, V. B.; Kasinova, G. V. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR; 199: No. 2, 460-3(11 Jul 1971). (In Russian).

Colonies of duckweed, taken from monomorphic left and right configurations of Lemna gibba, were irradiated once with 800 R of x radiation. Vegetatively-reproduced individuals and clones were examined for deformities, monstrosities, and other variants. The changes in these with further cultivation for about six months are summarized. (K.S.W.)

15430 DISTURBANCES OF MEIOSIS OF COTTON PLANTS UNDER THE INFLUENCE OF VARIOUS PHYSICAL FACTORS. Agaev, Yu. M.; Sendova, R. A. Dokl. Akad. Nauk Azerb. SSR; 27: No. 4, 59-64(1971). (In Russian).

The course of meiosis was studied in the anthers of cotton plants grown from seed that was exposed to: 0.5 to 60 kR of gamma radiation, or to varying unipolar electrical fields (40 to 50 Hz) at 2,500 volts for varying lengths of time. Meiosis and microsporogenesis were altered as a result of radiation in excess of one R, or as a result of exposure to the electric field treatment for at least 120 sec. (K.S.W.)

15431 GAMMA IRRADIATION OF MOISTENED SEEDS OF CREPIS CAPILLARIS. Abilov, A. N. Dokl. Akad. Nauk Azerb. SSR; 27: No. 4, 55-8(1971). (In Russian).

The interaction of two doses of gamma radiation on moistened seeds of Crepis capillaris was investigated. Of three groups of seeds, one was given a dose of 5,000 R, one was similarly irradiated, moistened, and then irradiated a second time. The timing of the exposure to the second dose was varied from one hr to 26 hr after the seeds were wetted. A third group of seeds was moistened and then irradiated only once. The chromosomal aberrations were analyzed in the metaphase of the first mitosis. An increased number of aberrations resulted only when an interval of one hr elapsed between irradiations; larger time intervals produced somewhat fewer aberrations. Other comparisons were made of timing and magnitude of radiation doses. (K.S.W.)

15432 SIGNIFICANCE OF INTEGUMENTS IN CARYOPSES OF TRITICUM DURUM DESF. TREATED WITH X RAYS. Ortu, Alba Marchioni (Univ., Cagliari, Italy). G. Bot. Ital.; 104: No. 6, 435-42(1970). (In Italian).

Experiments were carried out on Triticum durum "Cappelli" to test the influence of seed coats on the damage by x rays. The damage was evaluated in terms of germination, seedling growth, and chromosomal aberrations. Seeds in which the embryo was covered (with pericarp and spermoderm), uncovered (without pericarp), and bared (without pericarp and spermoderm), were irradiated at the total exposure of 1000, 2000, and 4000 R of x rays. The growth of seedlings from covered and uncovered embryos, x-rayed at 1000 R, was better than that of bared embryos. The chromosomal aberrations analyses carried out in root meristem cells at anaphase, during the first mitotic cycle, show the highest damage in seedlings coming from uncovered and bared embryos and the type of aberrations was almost chromatidic (B^1). It is suggested that the removal of the integuments (pericarp and spermoderm) could possibly accelerate the process of germination, and could also produce in the embryo a greater sensitivity to x rays. (auth)

15433 MUTATIONAL EFFICIENCY OF THERMAL NEUTRONS IN LENS ESCULENTA (MOENCH). Uhlik, J. (Vysoka Skola Zemedelska, Prague). Biol. Plant. (Prague); 13: No. 4, 216-23(1971).

First findings on mutation efficiency of thermal neutrons in lentil are presented: The proportion of segregating progenies with chlorophyll mutants and chimeric plants reached a maximum of 22% when doses of 1.6×10^{12} and 2×10^{12} n/cm^2 were used. After irradiation with doses from 2×10^{12} to 2.6×10^{12} n/cm^2, in 2 to 4% of the offsprings different chlorophyll mutants were produced at the same time. The maximum proportion of progenies in which only viridis mutants were segregated was 18%, that with xanthoviridis mutants alone was 6%, with xantha 4%, with albina alone 2%, and with chimeric plants alone was 8%. The highest number of different mutant types in the same progeny together with different combinations of two mutant types in the same progeny were induced by doses of 2×10^{12} and 2.3×10^{12} n/cm^2. The highest number of induced chlorophyll mutants per 1 offspring was 0.44 mutants after irradiation with 2.3×10^{12} n/cm^2. The highest number of chlorophyll mutants per 100 planted seeds was 1.46 mutants after irradiation with 3×10^{12} n/cm^2. (auth) (INIS)

15434 MONOGENIC MUTATION SIMULATING CONTINUOUS VARIATION. Rana, R. S.; Kharkwal, M. C. (Indian Agricultural Research Inst., New Delhi). Curr. Sci. (India); 41: No. 1, 38 (5 Jan 1972).

Observations during a period of ten years on the range of phenotypic variation regarding flower-form generated in the progenies of an x ray induced male-sterile mutant in Cosmos are reported. The mutant was induced in a Chelsea variety of the ornamental plant Cosmos bipinnatus whose dry seeds were irradiated with an acute x ray dose of 15 kR at an operating voltage of 50 kV^5. This variety invariably produces single type inflorescences characterised by a single whorl of eight sterile ray florets surrounding a bunch of hermaphrodite disc florets. The mutant produced pistillate flowers of the double type having five to eight additional whorls of rays which were male-sterile, all the hermaphrodite disc florets having been transformed into pistillate rays. A recombination analysis revealed that the mutant condition was inherited as a monogenic dominant trait. (C.H.)

15435 EFFECT OF GAMMA RADIATION ON PEACHES. Khan, Ismail; Sattar, Abdus; Ali, Mumtaz; Muhammed, Amir (Radiation Genetics Inst., Lyallpur, Pakistan). Nucleus (Karachi); 8: No. 3, 117-22(Jul-Sep 1971).

The effect of γ irradiation on ethylene production, ripening, and quality characteristics of peaches was studied. Radiation doses between 100 and 300 kR stimulated ethylene production, and resulted in the hastened ripening of peaches. Doses higher than 300 kR adversely affected the flesh firmness, rendering the fruit unfit for consumption. (auth)

15436 SENSITIVITY OF SEEDS OF SOME FOREST SPECIES TO THE ACTION OF GAMMA RAYS. Chira, E. (Inst. for Dendrobiology, Mlynany, Czech.); Kantor, J. Acta Univ. Agr. (Brno), Ser. C; 39: No. 4, 315-23(1970).

Seeds of some forest species were exposed to the action of gamma rays in doses ranging from 0 to 100 kr. In the majority of seeds treated this irradiation showed inhibitive effects on the numbers of emerged seedlings, and its action proved stimulative in two instances only; height of the seedlings was found unaffected by the treatment. Moreover, the critical and lethal doses of gamma rays were determined for seeds of the species examined. (auth)

15437 NATURE OF ACHROMATIC LESIONS (GAPS) INDUCED BY X RAYS IN CHROMOSOMES IN VICIA FABA. Scheid, W.; Traut, H. (Univ., Muenster, Ger.). Z. Naturforsch., 26b; No. 12, 1384-5(Dec 1971).

Seedlings of Vicia faba were x-irradiated with a 100 R dose. Chromosomes were isolated and gaps were analyzed and stained with the Feulgen reagent. Strands containing DNA were observed in the gaps using the light microscope. In other experiments isolated chromosomes were treated with dyes specific for DNA and RNA and DNA-containing strands were observed using the fluorescence microscope. These experiments confirmed the results of previous experiments. (H.L.W.)

15438 RELATIONS BETWEEN PHENOTYPIC ABERRATIONS AND LOSS OF REPRODUCTIVE INTEGRITY IN TRADESCANTIA STAMEN HAIRS. Underbrink, A. G.; Sparrow, Rhoda C.; Sparrow, A. H. (Columbia Univ., New York. Brookhaven National Lab., Upton, N. Y.). Radiat. Bot.; 11: No. 6, 473-81 (Dec 1971).

Cuttings of Tradescantia clone 02 bearing young inflorescences were irradiated with 0.43 MeV neutrons (0.163–24.4 rad). Others were irradiated with 250 kVp x-rays (11.5 to 432 rad). Stamen hairs were scored in opened flowers up to day 23 postirradiation for hair length (a hair survivor ≥12 cells long) and the type of somatic aberration or mutation within each hair. Distribution of numbers of cells per hair at various doses for both treatments, for the normal and aberrant hair types, were compared, and survival curves were constructed separately for normal and aberrant hairs. The distribution of hair lengths, and survival curves were used as criteria for measuring loss of reproductive integrity (LRI). Shorter hairs tend to occur in association with a phenotypic aberration, although aberrations can occur also in hairs of normal length. The results suggest that LRI is definitely associated with and possibly caused in part by the same event responsible for the presence of a phenotypic aberration. In aberrant stamen hairs, the surviving fraction is reduced by more than a factor of 2 following irradiation compared to that of normal hairs. (auth) (UK)

15439 STATUS AND PROBLEMS OF FOREST RADIOECOLOGY. Aleksakhin, R. M.; Tikhomirov, F. A.; Kulikov, N. V. (Lab. of Forestry, Moscow. Moscow State Univ. Inst.

of Ecology of Plants and Animals, Sverdlovsk, USSR). Ecology (USSR) (Engl. Transl.); No. 1, 19-27(Jan-Feb 1970).

Translated from Ekologiya; No. 1, 27-38(Jan-Feb 1970).

A review is presented of the contemporary status of forest radioecology in the USSR, and the basic problems and directions for study in this area are indicated. Investigations on migration, distribution, and biological effects of radionuclides in forest biogeocenoses are examined in detail. Studies on responses of deciduous and coniferous species to ionizing radiation and correlations between radiosensitivity and chromosome size are reviewed. Ecological factors such as population number, reproductive ability and death rate of irradiated species, and biomass are discussed with regard to their effects on resistance of forest associations to radiation. (H.L.W.)

15440 INITIAL MATERIAL FOR SUNFLOWER BREEDING BY γ-RAY AND X-RAY. Tsvetkova, F. Genet. Selek.; 3: No. 3, 231-7(1970). (In Bulgarian).

The highest percentage of useful mutants of sunflowers was obtained following exposure of seeds to x radiation. It was found that different varieties responded differently to irradiation. Beneficial characteristics such as a large leaf area and a short growth period were developed as a result of irradiation. These characteristics are of value in sunflower breeding. (INIS)

15441 EFFECTS OF GAMMA IRRADIATION IN BARLEY AT DIFFERENT DEVELOPMENT STAGES. Sutka, J. (Univ. of Agricultural Sciences, Goedoelloe, Hungary). Acta Agron. (Budapest); 20: No. 3-4, 339-49(1971).

The spring barley variety MFB 104 was irradiated at different stages of development (tillering, shooting, meiosis, flowering, embryogenesis) in the gamma field at Gödöllő. In the M_1 generation, stalk length, fertility, and grain weight decreased while the number of laterals per plant increased. Meiosis was the most reactive phase, while at the stage of embryogenesis plants of the M_1 generation gave no response to irradiation, and even in the M_2 generation only a slight change could be observed. In the M_2 generation, irradiation with a dose of 1944 R at the stage of tillering resulted only in a mutation rate of 2.61%. Generation M_3 was evaluated on the basis of a chlorophyll test. With increased doses the frequency of mutations changed. A comparison of phases revealed that the highest mutation frequency was induced by irradiation in the phases of meiosis and embryogenesis. Treatment at the time of tillering caused but little visible chlorophyll mutation when, however, mutation frequency was converted to mutation rate, the latter value was close to the mutation rates in the other phases. The mutation rate of 7.17% obtained with irradiation in the phase of embryogenesis is, in fact, a higher value, but the mutations produced in multicellular zygotes could not be distinguished from those induced in unicellular zygotes with the method applied. Irradiation in the different phases of development changes the spectre of chlorophyll mutations too, though no definite regularities could be established. (auth)

15442 ACCUMULATION OF CHLOROPHYLL IN THE PRIMARY LEAVES OF PHASEOLUS VULGARIS L., IRRADIATED IN THE PRESENCE OF AET OR CYSTAMINE. I. UPTAKE, DISTRIBUTION, AND INCORPORATION OF CYSTAMINE AND AET IN THE PRIMARY LEAVES. Kirchmann, R.; Bonotto, S.; Van Puymbroeck, S. (CEN/SCK, Mol, Belg.). Radiat. Bot.; 11: No. 6, 411-17(Dec 1971). (In French).

The use of AET-^{35}S and of cystamine-^{35}S showed that these chemical protectors can penetrate the tissues of the primary leaves of Phaseolus vulgaris L.; the highest penetration occurring when the leaves are immersed in the solution of these compounds. The presence of the labelled protectors in the plastids fraction was shown, consequently the plastid membrane is permeable for these sulfhydryl compounds. The incorporation of AET-^{35}S in the cellular metabolism of the primary leaf was demonstrated. (auth) (UK)

15443 COMPARISON OF THE EFFECTS OF SIMULATED FALLOUT DECAY AND CONSTANT EXPOSURE-RATE GAMMA-RAY TREATMENTS ON THE SURVIVAL AND YIELD OF WHEAT AND OATS. Bottino, P. J.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot.; 11: No. 6, 405-10(Dec 1971).

Eight-day-old seedlings of wheat (Triticum aestivum) and oats (Avena saliva) were subjected to ^{137}Cs gamma radiation for 16 hr with constant rate exposures (CR), and for 36 hr with changing exposure rates given as a fallout decay simulation (FDS). After irradiation the wheat was transplanted to the field, and the oats into 6-in. clay pots and placed in a screen-covered greenhouse. Survival data were collected three times a week until no more deaths, attributable to the radiation occurred. Seed yield data from survivors were obtained at the end of the growing season. At equal total exposures, the 36-hr FDS treatment was more effective in reducing survival than the 16-hr CR treatments. The ratio of 16-hr CR/FDSLD_{50}'s was 1.46 for wheat and 1.19 for oats. The FDS was more effective in reducing the yield only at exposures above the LD_{10}. The FDS exposures producing a 50% reduction in seed yield (YD_{50}) were 1.73 ± 0.29 kR for Opal wheat and 1.42 ± 0.27 kR for Orbit oats. The 16-hr CR YD_{50} exposures were 2.26 ± 0.61 kR for wheat and 1.51 ± 0.22 kR for oats. In all cases, yield was a much more sensitive end point than survival, indicating that even though a crop might survive fallout exposures in some cases, no appreciable seed yield would be produced. That is, reproductive survival (seed) is more sensitive than somatic survival (plants). (auth) (UK)

15444 STUDIES OF THE DEPENDENCE ON ENERGY OF THE BIOLOGICAL EFFECTS OF FAST NEUTRONS. I. GROWTH REDUCTION AND CHROMOSOME ABERRATIONS OF HORDEUM VULGARE AND VICIA FABA. Hamann, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Hanover). Radiat. Bot.; 11: No. 6, 425-36(Dec 1971).

The effects of 3.4-MeV and 14.7-MeV neutrons on seeds of Hordeum vulgare and Vicia faba were compared. The neutrons were produced by the reactions ^{2}H(d,n)^{3}He and ^{3}H(d,n)^{4}He using a 600-keV cascade accelerator. Biological response was measured in terms of growth inhibition and frequency of chromosome aberrations. A measure of effectiveness R(E) (E = neutron energy in MeV) was used in the case of growth inhibition the constant reactivity of the exponential part of the dose effect curve, and in the case of aberration induction the aberration frequency per unit dose. The ratio R(14.7)/R(3.4) of the effectivenesses for the two neutron energies is: 1.0, 0.93, 0.92, 1.1, 0.93 in the case of growth inhibition of the first leaf of barley, frequency of double bridges in barley root tips, growth inhibition of the main root of Vicia faba, frequency of double breaks, and fraction of aberrant cells in Vicia faba root tips respectively. The ratio is almost independent of the observed effect and about equal to the ratio 0.85 of quality factors. Therefore, an estimation of the energy dependence of the fast neutron effects should be possible by means of these factors. (auth) (UK)

15445 FORAGE PRODUCTION OF PEARL MILLET HYBRIDS GROWN FROM SEED EXPOSED TO LOW DOSES OF GAMMA RAYS. Burton, G. W.; Powell, J. B.; Constantin, M. J. (Dept. of Agriculture, Tifton, Ga. Univ. of Georgia, Tifton). Contract AT(40-1)-2976. Radiat. Bot.; 11: No. 6, 447-51(Dec 1971).

Seeds of three pearl millet varieties (Gahi 1, Millex 22 and Tift 23 × 186) received γ ray dosages of 0, 150, 300, 600, 1200, 2400, 4800, 9600, and 19,200 R just before planting in 1969 and 1970. Repeating three times each variety-treatment combination in a 9 × 9 lattice square field test gave coefficients of variability (CVs) of 8.0 and 8.2% for total 1969 and 1970 yields and made average dosage effects 3.4% different than the control. Millex 22 and Tift 23 × 186 yielded 5.1 and 15.9% more forage respectively than Gahi 1. Exposing seeds to γ rays ranging from 150 to 9600 R failed to significantly increase forage yields in either year. Exposing seeds to 19,200 R reduced forage yields 9.5% ($P > 0.01$). Dry matter yields of 9-day-old seedlings grown in growth chambers tended to parallel field results. Dry weights of 8-day-old seedlings decreased from 1.50 to 0.10 g as seed exposure to γ increased from 6 to 54 kR. Gahi 1 was most tolerant of heavy γ ray seed treatment. No evidence of radiation-induced stimulation was observed. (auth) (UK)

15446 CORRELATIVE INHIBITION OF ROOT EMERGENCE IN THE GAMMA-IRRADIATED COLEUS LEAF. I. PREMORPHOGENIC LEVELS OF AUXIN, RNA, AND METABOLITES IN THE PETIOLE BASE. Gordon, S. A.; Gaur, B. K.; Woodstock, L. (Argonne National Lab., Ill.). Radiat. Bot.; 11: No. 6, 453-61 (Dec 1971).

Exposure of the lamina of the Coleus leaf to γ radiation inhibits the formation of adventitious roots in the shielded base of the petiole. This abscopal effect on morphogenesis is associated with a sequential reduction in the levels of auxin, RNA and protein in the petiole base, before differentiation occurs. The levels of soluble carbohydrate and nitrogen, nucleotides, and rates of RNA synthesis in these tissues appear not to be involved initially in the radiation effect. (auth) (UK)

Radiation Effects on Animals (External Source)

Man

Refer also to abstract 15417.

15447 (BNL-16279) RECOVERY, REOXYGENATION, AND A STRATEGY TO IMPROVE RADIOTHERAPY. Elkind, M. M. (Hammersmith Hospital, London (England)). [1970]. 55p. (CONF-711036-1). Dep. NTIS.

From Conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971).

Optimal radiotherapy means an optimal differential response between the tissue at which the beam is directed and the normal tissue that is incidentally irradiated. To achieve this, various approaches have been tried, not all of which have a rational basis. One approach that is rational in concept is to increase the effectiveness of radiation by sensitizing target tissue, or protecting normal tissue, by means of ancillary drug therapy. Another approach, supported by experiment, is to use radiations of greater biological effectiveness, e.g. neutrons and pi mesons, to achieve the same end. Usually, the strategy underlying the latter departure stems from the findings that significant portions of tumors are protected by hypoxia and that high LET (linear energy transfer) radiations give rise to reduced OER's (oxygen enhancement ratios) compared to x or γ rays. As a consequence tumor tissue, irradiated with a high LET beam, responds relative to normal tissue, as though it had been differentially sensitized. Thus, physical sensitization via a high LET beam, or chemical sensitization via a drug treatment that differentially sensitizes target tissue, and particularly hypoxic tumor tissue, constitute two similar approaches to the improvement of radiotherapy. Data are reviewed from a number of studies on the survival of cultured cells that emphasize the importance of reoxygenation of hypoxic cells between radiation dose fractions for regeneration and survival. (29 references) (C.H.)

15448 (LA-DC-13266) RISK-BENEFIT QUANTIFICATION. Otway, H. J. (Los Alamos Scientific Lab., N. Mex.). [1971]. 27p. (CONF-711123-1). Dep. NTIS.

From Symposium on risk vs benefit analysis: solution or dream; Los Alamos, N. Mex. (11 Nov 1971).

Quantitative radiation benefit-risk analyses for the human population have been attempted recently but no formalism has evolved and been accepted. Those first suggesting a calculus of benefit-risk analysis felt that quantification of such values as human life and aesthetic values would be a difficult and time-consuming process, if possible at all. A survey of the literature reveals that many of these judgments have already been made in preliminary form and techniques exist for determining others. It is concluded that, with a proper interdisciplinary effort, performance of risk-benefit analyses is within reach, and that as such studies continue and more is known about the perception of subjective values, subsequent efforts will become easier. It is postulated that benefit-risk evaluations can neither be performed nor developed by task forces of experts because there are no experts yet and no group of experts can judge the values and opinions of the people to be affected by a proposed activity. The acquisition of the required information is, however, within scientific capabilities if an appropriate research effort is made. (auth)

15449 (LBL-331) RADIATION AND RISK: THE SOURCE DATA. Patterson, H. Wade; Thomas, Ralph H. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1971. Contract W-7405-eng-48. 52p. (CONF-710716-2). Dep. NTIS.

From sixth symposium on mathematical statistics and probability; Berkeley, Calif. (19 Jul 1971).

With respect to physical and chemical components in the natural environment other than radiation, it would seem that Man has, through evolutionary processes, been adapted to function adequately over a rather broad range of exposure. Examples of this are carbon dioxide concentration in air, temperature, and barometric pressure. Observing this, we might be tempted to posit that Man's response to radiation exposure would be similar. However, as scientists we must stress that we do not know the effect of small exposures to radiation on human beings. We do not know whether such exposures are deleterious, of no consequence, or beneficial. It is perhaps true that more is known of Man's response to ionizing radiations than to any other self-inflicted pollutant of his environment. This is largely due to the experience of radiation injury resulting from early uses of x-rays and radioactive substances, particularly radium. From these early experiences and from studies on certain other groups of individuals subjected to high radiation exposures as a result of radiotherapy, nuclear weapons attack, or radiation accidents, a limited amount of information has been pieced together. Such information is almost entirely about the effects of large exposures and high dose-rates. If we are to make any progress in the difficult task of understanding the possible deleterious effects on the health of the population due to small exposures to ionizing radiation at low dose rates it is clear that much greater efforts at interdisciplinary studies are needed. Man's natural radiation environment results in whole-body exposures that vary from about 100 mrem/y to an upper limit of a few rem/y. Man-made radiation levels are, with one exception, small compared even with the fluctuations in these natural levels due to geography and personal habits. The one exception is due to exposure during medical radiology. (auth)

15450 (UR-3490-5) IMPORTANCE OF VASCULARITY, TUMOR BED, AND OTHER GENERAL ASPECTS IN RADIOSENSITIVITY. Casarett, George W. (Rochester Univ., N. Y. School of Medicine and Dentistry). [1970]. 34p. (CONF-711036-2). Dep. NTIS.

From Conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971).

The relative importance of the supporting tissues and vascularity of tumors to the radiosensitivity of the parenchymal cells and tissues of organized tumors and in the response of tumors to ionizing radiation are considered in the context of radiotherapeutic practice. Radiosensitivity not only at the time of the first radiation exposure, but also the changes in radiosensitivity caused by each exposure in any of the schemes of fractionated exposure used in radiotherapy, is considered. It is pointed out that it is a gross oversimplification to assume that tumors are homogeneous populations of cells existing in similar states and under similar conditions, and undergoing similar changes in radiosensitivity at similar times in response to changes in growth rate or to exposure to similar doses or temporal modes of irradiation, and that there are many variables which influence the initial radiosensitivity of tumors and the direction, the time, and the degree of radiation-induced changes in radiosensitivity of tumors. Depending upon the nature of the tumor and its response to irradiation, the size of the radiation dose fraction, and the time interval between dose fractions, some of these variables may act together to enhance the radiosensitivity of a tumor to particular dose fractions, or may oppose each other to offset their individual effects on radiosensitivity of the tumor, or may act together to depress the radiosensitivity of the tumor to particular dose fractions. At any particular time in the course of fractionated radiotherapy it is the net result of the influences of these many variable modifying factors which determines the direction and degree of change in radiosensitivity of the tumor to the next dose fraction. These radiosensitivity modifying factors are listed and discussed. (35 references) (C.H.)

15451 RADIATION CANCERS AND A-BOMB SURVIVORS. Stewart, A. (Oxford Univ.). Lancet; 2: No. 7735, 1203 (27 Nov 1971).

It is pointed out that the population of A-bomb survivors used for detecting effects of low-level radiation was not assembled until October 1950. Doubt is cast on the assumption that prevailing living conditions in the bombed cities before 1950 did not affect recognition of radiogenic cancers with latent periods of more than five years. Attention is drawn to a recent study of flood victims, where cancer deaths rose during the 12 months after the disaster. It is suggested that the threshold paradox would be explained if it were assumed that there were among the non-survivors a disproportionately large number of children incubating non-radiogenic cancers, and therefore a corresponding shortage of cancers of the young among the survivors. (UK)

15452 CHILDHOOD CANCER FOLLOWING OBSTETRIC RADIOGRAPHY. Newcombe, H. B.; McGregor, J. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Lancet; 2: No. 7734, 1151-2(20 Nov 1971).

Data on the incidence of neoplasms in children exposed to x radiation in utero during diagnostic radiography of the mother were reanalyzed to derive a dose/effect curve using the chi-square method. The resulting weighted mean relative incidences for different dose ranges were plotted. The results showed a simple linear relationship between the reported numbers of juvenile deaths from cancer and obstetric irradiation, down to a dose range of 200 to 250 millirads. It is suggested that the results indicate there is no safe threshold for neonatal exposure. (UK)

15453 CASE OF HYPOPLASIA OF TEETH AND MAXILLA FOLLOWING RADIOTHERAPY OF RETINAL GLIOMA. Riokawa, Tatuo; Amari, Eiichi; Yanagisawa, Toru (Iwate Medical Coll., Morioka, Japan). Syoni Shikagaku Zasshi; 7: No. 2, 117-23(Dec 1969).

A nine year old girl who had had her right eye removed for retinal glioma at the age of three years and one month was examined. At the time of surgery, infiltration of tumor cells into the cut end of the optic nerve was found and a large dose of x irradiation (2400 and 3000 R) was given twice, and Mitomycin-C was administered (20 and 23 mg) over a long period. There was no indication of recurrence of the glioma but a secondary effect of irradiation was observed as growth retardation in the maxilla, face, and teeth.

Examinations revealed that the direct effect of x irradiation appeared as depilation of eyebrows, atrophy of facial skin, disappearance of pigments, and extension of capillary vessels. Growth retardation was observed in the central part of the face, especially the exposed (right) side of the face. Reversed occlusion of the front teeth was considered to be due to malformation of the maxilla, and traumatic occlusion was found in upper and lower front teeth. Marked retardation of tooth formation was observed, especially five which were only a trace of a tooth. (TSS) (Japan)

15454 CHILDHOOD CANCER FOLLOWING OBSTETRIC RADIOGRAPHY. Russel, J. G. B. (St. Mary's Hospital, Manchester, Eng.). Lancet; 2: No. 7737, 1320(11 Dec 1971).

Data on the incidence of neoplasms in children exposed to x radiation in utero are reviewed. It is concluded that pregnant women exposed to receiving x rays during diagnostic radiography contribute a higher proportion than average to the high risk groups. It is estimated that there is an increase in cancer of approximately 20% resulting from radiation exposure in utero, and that there is an estimated 10% increase in cancer with exposure for each antenatal x-ray film. The figures indicate a dose/response relationship. (TSS) (UK)

15455 CONCENTRATED IRRADIATION. CONCENTRATED PALLIATIVE RADIOTHERAPY FOR TUMOURS AFFECTING THE OESOPHAGUS, BRAIN, BONES, AND MEDIASTINUM. Dutreix, J.; Schlienger, M.; Chauvel, C.; Daguin, R. (Institut Gustave Roussy, Villejuif, France). Ann. Clin. Res.; 3: 9-15(1971).

A particular type of rapid palliative radiotherapy is described, composed of 2 sessions of 850 rad or 650 rad, delivered with a 48 hour interval. This concentrated irradiation is well tolerated. It is most useful for palliative radiotherapy and preoperative radiotherapy. It can, however, also be considered as the first part of a split course of curative radiotherapy. The authors give the radiobiological rationale of the treatment and the early results of its use in 158 patients. Treatment of 44 patients with carcinoma of the oesophagus resulted in a definite improvement of symptoms, in 19 patients treated for mediastinal compression a durable relief from compression symptoms was observed. In 43 cases with bone metastases, pain disappeared completely in one-third and was significantly relieved in another third of the cases. The tolerance was good in 52 cases of brain tumors with 19 patients still alive 1 to 4 years later. (auth)

15456 RESTORATION OF FERTILITY FOLLOWING UNILATERAL ORCHIECTOMY AND RADIATION THERAPY FOR TESTICULAR TUMORS. Amelar, Richard D.; Dubin, Lawrence; Hotchkiss, Robert S. (French and Polyclinic Medical School and Health Center, New York. New York Univ. Medical Center, N. Y.). J. Urol.; 106: No. 5, 714-18(Nov 1971).

Five men, four of whom had previously determined normal fertility levels, were subjected to unilateral radical inguinal orchiectomy and postoperative radiation therapy for testicular tumors (4 seminomas and 1 teratocarcinoma). In these patients the semen quality became extremely poor following therapy, only to be restored to normal fertile levels within 3 to 4 years of therapy. Three of these patients subsequently fathered apparently normal children. Two additional patients with seminoma, who previously had determined poor semen qualities, were subjected to similar therapy and were rendered azoospermic. Four years later they were restored to their former poor semen qualities. Hence one can infer that unilateral orchiectomy and radiation therapy are only temporarily detrimental to male fertility. (auth)

15457 DEVELOPMENT OF CURRENT RADIATION PROTECTION PRACTICES IN DIAGNOSTIC RADIOLOGY. Bushong, Stewart C. (Baylor Coll., Houston, Tex.). CRC Crit. Rev. Radiol. Sci.; 2: No. 3, 337-425(Sep 1971).

The development of radiation protection standards and radiation control practices in diagnostic radiology is reviewed from the time of Roentgen's discovery to the present. The development has spanned several eras of experience which are distinct, yet difficult to identify chronologically. The first era covers the time of the pioneers through approximately 1915. During this time, x rays were a novelty in the hands of physicists and physicians. Many radiation injuries, including deaths, were reported and untold numbers of injuries were unreported. For the most part, the injuries were acute and easily observed, and included most frequently skin erythema, desquamation, and epilation. The most severe injuries were malignant changes that often led to disfiguring surgical operations and death. During this time, only low kVp and low mA equipment was available which resulted in excessive exposure times and excessive differential patient dose relative to film exposure. The second era covers the time period from approximately 1915 to the 1940's. It was during this time that radiation protection standards were first developed in an official manner and that radiation control practices were established at the local level. These standards and practices were instituted initially because of the early radiation injuries and the martyrdom that befell so many early roentgen pioneers. With the institution of high capacity x-ray machines, reports of more subtle x-ray injuries appeared in the literature. These reports were primarily associated with the hematologic system and ranged from transient leukopenia to leukemia. The radiation standards and practices of this second era were established on the assumption of a threshold-type dose-response relationship. It was generally accepted that if one worked within the recommended levels of exposure, no deleterious effects would ensue to either the patient or the operator. The emphasis of radiation control procedures was still focused on maintaining acceptable exposures to the individuals involved in each examination and at each facility. Radiation research directed to genetic damage resulted in linear nonthreshold type dose-response relationships. These findings produced suspicion that other effects were also nonthreshold which led to a reevaluation of the theoretical basis for radiation protection. Many radiation scientists became convinced that the basis for radiation control at that time was false. If, in fact, long-term latent effects followed a linear nonthreshold type relationship, then radiation exposures should be maintained at an even lower level than was at that time acceptable. The nonthreshold hypothesis gained acceptance and continues to the present time. The final era of time covered by this review extends from the 1940's to the present day. During this time, acceptable radiation exposure levels have been reduced still further. The concern for radiation injury is no longer primarily directed to identifiable individuals, but rather to society at large, or at least population groups within society. Scientific reports relating identifiable human radiation injuries to diagnostic roentgenological activities have been virtually absent for 20 years. They have been replaced, however, by large-scale epidemiological investigations that have attempted to show effects at the population level following diagnostic levels of radiation. The current radiation protection standards and radiation control practices are based on consideration of not only the earlier human injuries but also the current epidemiological evidence. (C.H.)

15458 EFFECTS OF SUPERVOLTAGE AND INTRACAVITARY RADIOTHERAPY. Mackay, E. V.; Cockburn, K. G.; Roberts, S. J.; Musgrave, J. (Royal Brisbane Hospital, Australia). Australas. Radiol.; 15: No. 3, 255-8(Aug 1971).

A case report is presented of a patient given radical radiotherapy for an invasive carcinoma of the cervix at the twenty-sixth week of pregnancy. The infant, delivered by extended Cesarean hysterectomy at the thirty-third week, died on the third neonatal day from anemia and gastric hemorrhage. Post-mortem examination showed radiation effects on the scalp, the brain and meninges, bone marrow, and salivary glands. Because of a previal position of the placenta, a localized but uniformly severe reaction was observed in the lower two fifths of this organ. A brief review of the literature relating to the effects of irradiation on the human and animal fetus is given. (auth)

15459 CERVICAL MYELOPATHIES CAUSED BY RADIATION. REPORT OF 3 CASES. Figini, H. A.; Grosz, D. (Ramos Mejia Hospital, Buenos Aires). Prensa Med. Argent.; 57: No. 37, 1755-8(13 Nov 1970). (In Spanish).

The cases of three persons who had been irradiated in the neck for malignant processes and who after a time lapse of at least two years developed amiotrophies of the neck, shoulders, and upper limbs (especially the hands) are reported. The medical history and the results of the examinations are given. (J.S.R.)

15460 DIAGNOSTIC RADIATION AND THE PROTECTION OF THE PATIENT. Weeks, J. L. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Ind. Med.; 40: No. 5, 24-8(Aug 1971).

The reasons for current views on radiological protection are discussed in relation to medical practice. The need for careful evaluation of diagnostic procedures involving the use of ionizing radiation is emphasized, together with the need for achieving and maintaining high standards of radiological techniques. (auth)

15461 PYRIMESIN IN RADIATION SICKNESS. Sharma, U.; Sanyal, B.; Bapna, B. C. (AIIMS, New Delhi). Indian J. Radiol.; 22: No. 4, 229-31(1968).

A clinical trial of Pyrimesin is reported. Eighty-three patients of various malignancies treated by radiation techniques were surveyed using Pyrimesin—a new antiemetic compound and Pyridoxine. Under similar circumstances Pyrimesin is superior to Pyridoxine alone. At times a bad taste is noticed by the patient receiving Pyrimesin, which is not severe. (Indian Sci. Abstr.)

15462 RADIATION, CHROMOSOMES, AND MAN. Fitzgerald, P. H. (Christchurch Hospital, N. Z.). N. Z. Med. J.; 73: 147-54(Mar 1971).

The development of new techniques since 1956 for the study of human chromosomes is discussed with emphasis on tissue culture procedures, the use of hypotonic saline solutions for increasing cell size, separation of chromosomes by colchicine treatment, and the use of phytohemagglutinin for stimulating mitosis in lymphocytes. The advantages of using human lymphocytes for studies on radioinduced chromosome aberrations are pointed out and figures and diagrams of the most common types of aberrations are presented. A review is presented of in vitro and in vivo experiments on the relationship between aberration yield and radiation dose, and reasons for differences between in vitro data obtained in the United States, Britain, France, and Japan are discussed. Data are summarized that were obtained from in vitro studies of human lymphocytes following occupational radiation exposure, medical exposure to thorium-232 and x rays, radiation accidents, and exposure to atomic bombing in Hiroshima and Nagasaki. The possible biological significance of chromosome aberrations in man is discussed with emphasis on genetic consequences, effects of radiation on the frequency of spontaneous aberrations, and the relationship between radioinduced aberrations and neoplastic diseases. The use of aberration yields for biological dosimetry is reviewed and the following advantages of using chromosome aberrations as indicators of radiation dose are pointed out: the yield of aberrations is closely correlated with dose; blood cells are readily obtained and cultured; and lymphocyte populations have a long life span so that aberrations can be observed many years after radiation exposure. (H.L.W.)

15463 DELAYED HAZARDS OF RADON IRRADIATION. Camiel, Mortimer R.; Thompson, Donald (State Univ. of New York, Brooklyn). J. Amer. Med. Ass.; 219: No. 3, 384(17 Jan 1972).

The delayed carcinogenic hazards following the use of radon implants for therapy are discussed in relation to the radiation dose emitted. It is pointed out that the α radiation from ^{222}Rn is completely absorbed by the wall of the container and the therapeutic usefulness of ^{222}Rn lies in the emission of β and γ radiation by its daughter products, one of which is ^{210}Pb. For each millicurie of Rn originally implanted there would be approximately 0.1 μCi of ^{210}Pb left after 25 years, which emits a 47 keV γ ray. This can be detected with a γ scintillation probe. (C.H.)

Vertebrates

Refer also to abstract 15519.

15464 (COO-3097-1) SUPPRESSION AND RECOVERY OF COLONY FORMING UNITS IN THE RAT FOLLOWING SUB-LETHAL X-IRRADIATION. OKunewick, James P.; Phillips, Eleanore L. (Allegheny General Hospital, Pittsburgh, Pa.). [nd]. Contract AT(11-1)-3097. 6p. Dep. NTIS.

A single whole-body dose of 200 R x radiation was administered to rats; they were then killed at intervals following irradiation, the femurs were excised and the marrow removed. Suspensions of nucleated bone marrow cells were prepared and injected intravenously into recipient mice. Eight days later the mice were killed, the spleens excised and the colonies were counted. The data indicated that recovery of the total nucleated marrow occurred at a faster rate than recovery of transplantable colony forming units. A wide discrepancy was found between the recovery of total nucleated cells and that portion of the stem cell compartment constituted by transplantable colony forming units. (H.L.W.)

15465 (COO-3426-1) RADIOECOLOGY OF SMALL VERTEBRATE SPECIES UNDER NATURAL ENVIRONMENTS. Progress Report, 1960-1971. (Pittsburgh Univ., Pa.). Contract AT(11-1)-3426. 83p. Dep. NTIS.

Data are presented on the morphology, behavior, territoriality, population distribution, and plant species in the environment of the pocket gopher (Thomomys talpoides) and the chipmunk (Tamias striatus) in western United States and Canada. An experimental transect was established on the Beartooth mountains in Wyoming for studies on the effect of ionizing radiation on populations of gophers. Experiments consisted of exposing adult gophers of known age on the altitudinal plots to single doses of 0, 200, and 400 R of gamma radiation. As indicators of environmental stress, thyroid weights and ^{131}I retention curves were used. A figure is presented to show relative differences in the ^{131}I curves for the three elevations and results are tabulated for mean age specific mortality rates for free-ranging males and females. Ecological studies of chipmunks were conducted in Pennsylvania and the same procedure was used for radiation experiments as for pocket gophers. Computer storage of data made it possible to analyze data for developing a model of chipmunk populations. A figure is presented to show survival of chipmunks at different levels of radiation exposure. A greater survival was found among free ranging chipmunks. (H.L.W.)

15466 (COO-3777-38) ANASTOMOTIC SARCOMA OF IRRADIATED PARABIONT RATS. Warren, S.; Hurst, E. E. Jr.; Brown, C. E.; Chute, R. N. (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst. Chicago Univ., Ill.). [1971]. Contract AT(30-1)-3777. 17p. (CONF-710405-1). Dep. NTIS.

From sixty-second meeting of the American Association for Cancer Research; Chicago, Ill. (8 Apr 1971).

In a series of 1003 pairs of parabiosed rats, the right partner of which received 1000 rads total-body x irradiation, the incidence of soft-tissue sarcomas at the anastomotic site was 8.7%. The incidence in other parts of the irradiated partner was 5.8%, and in the nonirradiated partner was 0.3%. A combination of whole-body irradiation plus local factors of continuing trauma and scar formation was thought to account for the higher incidence of sarcomas in the anastomotic region. Systemic factors such as the endocrine system may also have played a secondary role. (auth)

15467 (EUR-4665) RESEARCH ON THE DIFFERENTIATION OF IMMUNOLOGICALLY COMPETENT CELLS. Final Report. Doria, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 29 Mar 1971. 16p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR Lit. 500.

A report is presented on the following lines of research: role of the thymus in the differentiation of immunologically competent cells; relation between erythropoiesis and antibody production in animals irradiated and transplanted with bone marrow; and analyses of the RNA of plasmocytes. (auth)

15468 (RT/BIO-(70)59) CATABOLISM OF THE DIFFERENT CLASSES OF IMMUNOGLOBULINS IN NORMAL AND LETHALLY-IRRADIATED MICE. Bazin, H. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). [1970]. 4p. Dep. NTIS (U. S. Sales Only).

The catabolism of different immunoglobulin classes was studied in normal and lethally irradiated mice. The catabolism of IgM and IgA was unchanged after irradiation. The half-lives of these proteins seemed to be approximately 12h. On the contrary, catabolism of three classes of IgG was increased after x-irradiation. It is suggested that this difference results from differences in the mechanism of catabolism. IgG molecules could be lost more rapidly when the gastro-intestinal tract is damaged by radiation. (auth)

15469 (TID-25890) FALLOUT RADIATION EFFECTS ON LIVESTOCK (PART A) AND FOOD CROPS (PART B). Annual Report, November 1, 1968-October 31, 1969. Bell, M. C.; Sasser, L. B.; West, J. L.; Wade, L. Jr.; Killion, D. D.; Constantin, M. J. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Contract AT-40-1-GEN-242. 65p. Dep. NTIS.

Sheep fed ^{90}Y-labeled fallout simulant at the rate of 2.5 mCi/kg to simulate 7% forage retention developed anorexia, diarrhea, and weight loss. Feed intake of the survivors usually returned to normal within 60 days. Beta irradiation of 57,000 rads to the dorsum of sheep, equivalent to 12% of the body surface, severely affected the skin and reduced body weight by 15% with no reduction in feed intake. Whole-body gamma irradiation of 240 R at 1 R/min affected only the platelets and white blood cells with no mortalities. These three types of irradiation given singly had little effect on mortality but when the three were combined, 4 of 8 sheep died within 60 days. In addition to mortality losses the loss of weight would severely affect the productivity of animals exposed to these levels of fallout. Preliminary data on cattle indicate that the combined radiation insults would be more detrimental to cattle than to sheep. Gamma ray sensitivity for major crops was as follows: winter barley = winter wheat > corn > soybean > rice. Seedlings of barley and wheat will tolerate ≈1 kR, corn ≈2 kR, soybean ≈4 kR, and rice ≈25 kR. Maximum yield reduction occurred in corn irradiated from 14 to 48 DAE (days after emergence), in winter barley from 175 to 200 DAE, and in winter wheat from 150 to 200 DAE. Yield reduction in soybean was maximal at early seedling stages and during early bloom. In the monocotyledonous plants sensitivity to gamma rays is greatest during the period of apical transition and extends through the period of reproductive primordial development. In the one dicotyledonous species studied, radiosensitivity was related to the early postemergence stage and during the period of early bloom. (auth)

15470 RADIOSENSITIZATION MECHANISMS OF DIPHENOQUINONE ON SUPRACELLULAR LEVEL. Astudillo, M. D.;

Alvarez, M. V.; Goicoechea, A.; Sanz, F. (CSIC, Madrid). Rev. Espan. Fisiol.; 27: No. 3, 183-9(Sep 1971).

Diphenoquinone was administered to mice orally or intraperitoneally in gum arabic or carboxymethyl cellulose. Methods are described for determining the toxicity and the radiosensitizing potentiation factor. The mice were x-irradiated at 26.5 R/min. Histological studies of the mice showed that diphenoquinone was very effective as a radiosensitizing agent, but that this effect was abolished by cysteine. These results indicated that the mechanism of radiosensitization could be explained by the sulfhydryl-binding action of diphenoquinone. (H.L.W.)

15471 LONG TERM CHANGES IN THE HEMOPOIETIC STEM CELL POOL OF ISOGENIC RADIATION: CHIMERAS. Duplan, J. F.; Monnot, P. (Institut du Radium, Paris). Compt. Rend. Soc. Biol.; 165: No. 2, 231-6(1971). (In French).

In destroying a part of the hemopoietic tissues, irradiation leads to the proliferation of stem cells, which may be counted by observing the number of clones arising from a single cell designated by the abbreviation CFU (colony forming unit). In the case of mice, having received a 100 percent lethal dose of irradiation, which have been injected with a known number of marrow CFU, these CFU are not capable of reconstituting either their own population or the various other components of the hemopoietic system. (France)

15472 RADIOBIOLOGICAL PROBLEMS ENCOUNTERED IN THERAPY WITH HIGH ENERGY ELECTRONS. Wambersie, Andre (Univ., Louvain, Belg.). J. Radiol., Electrol., Med. Nucl.; 52: No. 10, 574-81(Oct 1971). (In French).

Experiments were performed to evaluate the RBE of high energy electrons (15, 20, and 34 MeV) compared with high energy photons (^{60}Co γ or 20 MV × rays). The survival of mice following irradiation with 34 MeV electrons were compared with ^{60}Co γ irradiation using the split dose technique. Variations in the RBE as a function of depth were studied using 20 MeV and 15 MeV electron beams with isodose levels between 25 and 30 percent. The inactivation of microorganisms and chromosome aberrations in Allium cepa were used as biological dosimeters. Chemical dosimetry ($FeSO_4$) was used as a reference for high energy photons and electrons. (France)

15473 SURVIVAL OF SPANISH GOATS EXPOSED TO CONTINUOUS OR ACUTE IRRADIATION. Hupp, E. W.; Austin, J. W.; Krise, G. M.; Brown, S. O.; Szabuniewicz, M. (Texas A and M Univ., College Station). Int. J. Radiat. Biol.; 20: No. 5, 475-84 (1971).

Groups of male and female Spanish goats approximately 15 months old were assigned to radiation areas receiving ^{60}Co gamma radiation at average daily exposure of 0, 2.6, 7.2, 15, 30, and 40 R/20-hour day. The median lethal exposure at 7.2, 15, 30, and 40 R/day was 2650, 2415, 2450, and 2000 R, respectively, in females and 8330, 3600, 2770, and 2290 R, respectively, in males. Only 25 percent of the animals exposed to 2.6 R/day died from radiation effects during the 48.5 month period. The acute median lethal dose (80 R/hour) was 550 R. Survivors of the acute lethality studies were exposed to continuous irradiation at an exposure rate of 40 R/day beginning 86 days after the acute exposure. Median survival times did not differ significantly from controls not previously irradiated. (auth) (UK)

15474 EFFECTS OF IRRADIATION ON THE KINETICS OF PROLIFERATION AND DIFFERENTIATION IN CELL RENEWAL SYSTEMS. Fabrikant, Jacob I. (Univ. of Connecticut, Farmington). CRC Crit. Rev. Radiol. Sci.; 2: No. 4, 525-75(Dec 1971).

The response of the various tissues of the body of animals to acute and continuous irradiation depends in large part on the proliferative characteristics of cells in the system. Some valuable information from studies on acute radiation exposures of cultured mammalian cells provides a basis for an understanding of underlying mechanisms and it is becoming apparent that factors involved include both cell cycle effects and cell population effects. Little is known about the dose rate dependence of the initial cellular injury and its relation to intracellular recovery, but clearly, these are the determining factors in the observed response. In addition, until a better understanding of the variation of sensitivity over the cell cycle and its changing characteristics in the radiation-perturbed system becomes available, an understanding of the extent of injury and elimination of radiation damage from generation to generation will remain limited. The experimental evidence reviewed indicates that there are very great differences in the response under continuous irradiation between the various renewal tissues of the body. The factors which lead to these differences necessarily involve those intracellular and extracellular control mechanisms which regulate cellular proliferation and differentiation, and thereby control population levels and physiological function. Cellular radiosensitivity may be quite different in the various precursor cells. It may very well be that radiation damage affecting the speed and efficiency of regeneration may be less for certain precursor cells; for example, in the small intestine, than for precursors of hematopoietic tissues, and for seminiferous epithelium. It could be a function of a control mechanism such as the cell cycle time, on the one hand, or the presence of a radioprotector or some similar modifier, on the other. The homeostatic control mechanisms influencing the speed and efficiency of recovery during continuous exposure, in addition, may be quite different, and it would be expected that the capacity for compensatory cell proliferation may be much greater in the bone marrow than in the testis. It must also be recognized that changes in the tolerance of cells to irradiation differ after the initial and subsequent radiation injuries and under continuous exposure, changes in the response of cells may differ both in magnitude and time. The indirect effect of damage to the supporting structures of the tissue may differ in importance, either in the extent of general tissue damage, such as capillary damage and hemorrhage in the bone marrow limiting cell proliferation, or in the presence of radiation protectors, possibly serotonin, mucopolysaccharides, or conditions of anoxia, which may be present in the intestinal epithelium. (C.H.)

15475 EFFECTS OF VARIOUS DOSES OF WHOLE-BODY GAMMA IRRADIATION ON HEPATIC NITROREDUCTASE IN MICE. Shysh, A.; Noujaim, A. A. (Univ. of Alberta, Can.). Can. J. Pharm. Sci.; 6: No. 3, 73-5(1971).

Groups of mice were exposed to whole-body γ irradiation in doses of 300R, 600R, 950R, and 1200R. At various post-irradiation intervals the activity of hepatic ρ-nitrobenzoic acid reductase, microsomal protein level and microsomal cytochrome P-450 content were determined. An initial stimulation in reductase activity was noted during the first three post-irradiation days, with a subsequent abrupt decline. Recovery of the enzyme activity was seen following 300R and 600R, but not after 950R or 1200R. Reductase activity generally followed microsomal protein levels in the early post-irradiation stages and closely paralleled microsomal cytochrome P-450 content during the later post-irradiation period. (auth) (Canada)

15476 BETA RADIATION INHIBITION OF CORNEAL HEALING. I. TENSILE STRENGTH AND ULTRASTRUCTURE CHANGE. Morrison, Dennis R.; Kanai, Atsushi; Gasset, Antonio R. (Univ. of Florida, Gainesville). Invest. Ophthalmol.; 10: No. 11, 826-39(Nov 1971).

Radiation-induced changes in the corneal repair process have been correlated with a marked reduction in the tensile strength of the wound. These changes are characterized by: a prominent deficiency in the synthetic capability of the fibroblastic cells involved in the wound, abnormal ultrastructural detail of both these fibroblastic cells, and the epithelial cells that recover the incision; a complete lack of collagen synthesis in the stroma of the wound; and a marked absence of endothelial cells attempting to recover the incision and seal the wound posteriorly. Electron microscopic studies show that the pronounced ultrastructural changes in the corneal repair phenomenon are evident at radiation doses of less than half that required to produce any discernible damage or alteration in the intact cornea. The lack of tensile strength of the wound, the associated paucity of cells involved in the wound, and the abnormal ultrastructure of these cells were equally apparent in corneal wounds that had received the radiation either three months prior to surgery or immediately after wounding. (auth)

15477 EFFECTS OF SPERM ULTRAVIOLET IRRADIATION ON THE EMBRYONIC DEVELOPMENT OF RANA PIPIENS. Pogany, Gilbert C. (Northern Arizona Univ., Flagstaff). Develop. Biol.; 26: No. 2, 336-45(Oct 1971).

This investigation is concerned with the role played by irradiated sperm in the subsequent embryonic development of the frog Rana pipiens. The ultraviolet irradiation of the sperm was followed by the fertilization of untreated eggs. Determinations included mitotic index, nuclear diameter, chromosomal constitution, and percentage survival. Results show that the low-dose embryos were the most severely affected ones in spite of their diploid constitution. Embryos resulting from higher dosages of sperm irradiation were all haploid but showed less severe growth and cytological abnormalities. It is conjectured that radiation-induced damage to the sperm also involves its protamine moiety since considerable damage can occur without any alteration in the chromosomal constitution of the low-dose embryos. (auth)

15478 RADIATION-INDUCED LYMPHOPENIA. RECOVERY IN THYMECTOMIZED AND SPLENECTOMIZED GERM-FREE MICE. Anderson, Robert E.; Doughty, William E.; Howarth, John L. (Univ. of New Mexico, Albuquerque. Albuquerque Veterans Administration Hospital, N. Mex.). Arch. Pathol.; 92: No. 6, 480-3(Dec 1971).

Ninety-six germ-free mice were divided into the following experimental groups: intact; neonatal thymectomy; neonatal splenectomy; and neonatal thymectomy plus splenectomy. One half of each group was exposed to 700 rad of γ radiation at 6 weeks of age. Restoration of pre-exposure absolute lymphocyte values was very sluggish in the splenectomy groups and lacked the characteristic spike at day 24 postirradiation that characterized the intact group. However, the splenectomy groups approximated control values by day 32 postexposure. (auth)

15479 INHIBITION OF RADIOGENIC LYMPHOMA DEVELOPMENT IN MICE BY INTERFERON. Lieberman, Miriam; Merigan, Thomas C.; Kaplan, Henry S. (Stanford Univ., Calif.). Proc. Soc. Exp. Biol. Med.; 138: No. 2, 575-8(Nov 1971).

Long-term administration of interferon resulted in the partial suppression of radiation-induced lymphosarcoma development in strain C57BL mice. The inducer of interferon, polyinosinic acid–polycytidylic acid, was without effect under the same conditions. Interferon also protected C57BL mice against the induction of these tumors by a virus, RadLV, but did not modify the death rate following injection of tumor cells. (auth)

15480 HISTOCHEMICAL INVESTIGATION OF ALKALINE PHOSPHATASE AND GLYCOGEN IN BLOOD LEUKOCYTES DURING EXPERIMENTAL ACUTE RADIATION SICKNESS. Nekovaleva, N. A.; Rakhmatullaev, A. R.; Litvinenko, I. G. (Rostov Medical Inst., Rostov-on-Don, USSR. Uzbek Research Inst. of Hematology and Blood Transfusion, USSR). Med. Zh. Uzb.; No. 1, 68-70(1970). (In Russian).

In order to study histochemical changes in leukocytes caused by radiation, 19 rabbits were subjected to 1,000 R of whole-body ^{60}Co radiation, and given bone marrow transplants 24 h later. The glycogen and alkaline phosphatase contents in blood leukocytes were determined before and after irradiation at 7, 15, 20, 30, and 60 days. The data showed that transplantation of marrow promotes less variation in glycogen content in leukocytes during radiation sickness. A sharp increase in alkaline phosphatase was observed after 15 to 20 days following irradiation, which may be regarded as a reinforcement of oxidation-reduction processes brought about by transplantation of fresh bone marrow. (K.S.W.)

15481 ANTIRADIATION EFFECTIVENESS OF CYSTAMINE UNDER VARYING CONDITIONS OF GAMMA IRRADIATION. Vasin, M. V.; Saksonov, P. P.; Antipov, V. V.; Shashkov, V. S. Probl. Kosm. Biol.; 14: 121-31(1971). (In Russian).

It was established that with intraperitoneal injection of cystamine 5 to 10 min before γ irradiation (139 to 159 R/min), a linear dependence of radioprotective activity (RA), as determined from the cystamine dose reduction factor, on the drug dose is observable. Increasing the time of the injection of cystamine in a dose of 150 mg/kg (30 min before irradiation) had no effect on cystamine RA. Injection of cystamine 1 h before irradiation sharply lowered—and 8 to 12 h before completely canceled—cystamine RA. With doses of 50 to 100 mg/kg, a lowering of RA was noted in earlier stages. With irradiation for 1.5 to 4 h (total dose 950 to 1200 R) the RA of cystamine, cystaphos, 5-methoxytryptamine, and S, β-aminoethylisothiuronium bromide hydrobromide (AET) declined sharply. (JPRS)

15482 BIOCHEMICAL MECHANISMS IMPLIED IN THE SENSITIZATION OF LIVING ORGANISMS BY CHEMICAL AGENTS TO THE ACTION OF RADIATIONS AND CYTOSTATICS. III. THE ACTION OF HMB, IAA, AND CAFFEINE ON THE ACTIVITY OF DESOXYRIBONUCLEASE OF THE LIVER OF NORMAL AND IRRADIATED RATS. Furnica, Maria; Ganea, Adriana (Oncologic Inst., Bucharest). Rev. Roum. Biochim.; 8: No. 3, 211-18(1971). (In French).

p-hydroxymercuribenzoic acid (HMB) in doses of 15 mg/kg body weight and iodoacetamide (IAA) in doses of 15 mg/kg were administered to normal rats or to rats irradiated by 800 R. The activity of the hepatic DN-ase was followed. Three days after treatment, inhibition of the DN-ase appeared in the normal animals and a relative activation appeared in the irradiated animals. The activation of the DN-ase in the irradiated and radiosensitized animals can be implied in the inhibition of the restoration of the DNA injured by the irradiation. The caffeine in doses of 100 mg/kg body weight did not modify the activity of the hepatic DN-ase. (tr-auth)

15483 BIOCHEMICAL MECHANISMS INVOLVED IN THE CHEMICAL SENSITIZATION OF LIVING ORGANISMS TO RADIATIONS AND CYTOSTATICS. CHROMATOGRAPHIC VIEW OF DNA IN JENSEN TUMOURS LOCALLY IRRADIATED IN THE PRESENCE OF P-HYDROXYMERCUROBENZOIC ACID OR CAFFEINE. Furnica, M.; Spiridon, M.; Ganea, A. Rev. Roum. Biochim.; 8: No. 2, 117-22(1971). (In French).

Experiments were performed on tumor-bearing Wistar rats. Nine days after tumor grafting, the animals were subjected to: local irradiation of the tumor in doses of 3000 R; local irradiation in doses of 3000 R after the administration of 15 mg/kg/body weight of hydroxymercurobenzoic acid; local irradiation in doses of 3000 R after the administration of 100 mg/kg/body weight of sodium caffeine benzoate; and non-irradiated and non-treated tumors. Three days after treatment, the animals were sacrificed for tumoral DNA extraction. DNA extracted from radiosensitized irradiated animals is significantly different by its DNA chromatographic view from that of DNA extracted from irradiated tumors only. A similar chromatographic view was obtained for DNA extracted from hydroxymercurobenzoic acid radiosensitized animals and from caffeine-treated ones, a fact suggestive of the positive influence of hydroxymercurobenzoic acid on DNA recovery processes. (Rom. Sci. Abstr.)

15484 EFFECT OF CYSTAMINE IN A MIXTURE WITH SYMPATHOMIMETIC AMINES ON REPAIR PROCESSES AFTER EXPOSURE TO RADIATION AND OVERLOADS. Dobrov, N. N.; Kozlov, V. A.; Parshin, V. S.; Saksonov, P. P. Probl. Kosm. Biol.; 14: 285-8(1971). (In Russian).

Mice were subjected to γ irradiation (250 R) and the effect of acceleration on a centrifuge (15 and 30 units, 5 min) 50 min before and 30 min after irradiation. The radioprotector cystamine (100 mg/kg) in a mixture with amphetamine (1.5 mg/kg) and adrenaline (0.15 mg/kh) was injected intraperitoneally 55 min before irradiation, and in the event of combined exposure 5 min before overload. The rate of repair of the reversible portion of radiation damage, as determined from the half-recovery period of the animals' radioresistance, was used as the criterion of protective action. It was established that the protective action of cystamine is approximately equal for combined exposure and for irradiation alone. (JPRS)

15485 EFFECT OF RADIOPROTECTORS FROM THE MERCAPTOALKYL AMINE GROUP (S,β-AMINO-ETHYLISOTHIURONIUM) ON THE RESISTANCE OF ANIMALS TO TRANSVERSE OVERLOADS. Davydov, B. I.; Gaydamakin, N. A. Probl. Kosm. Biol.; 14: 7-25(1971). (In Russian).

A study using mice and rats was made of the effect of cystamine (I) and S,β-aminoethylisothiouronium bromide hydrobromide (AET; doses 50 to 150 mg/kg intraperitoneally) on the resistance (survival rate) of animals to overloads (centrifugation, 44.4 units; 30 min to 24 h after injection of I or AET). An equation was obtained describing the relation between the dose causing animals' death given 10-min centrifugation and the action of I and AET. Four hours after injection of radioprotectors, resistance to overloads becomes normal. Reduction with time in the depressant action of I and AET is due to elimination of the parmacological (toxic) effect. It was assumed that one of the possible mechanisms whereby the organism's resistance to overloads is lowered under the influence of I is the decrease in the glycogen reserves of the liver. (JPRS)

15486 EFFECT OF PHARMACOLOGICAL AGENTS ON REACTIVITY OF ORGANISM TO COMBINED EXPOSURE TO GAMMA IRRADIATION AND TRANSVERSE OVERLOADS. Gaydamakin, N. A.; Kul'kin, S. G.; Davydov, B. I.; Shashkov, V. S. Probl. Kosm. Biol.; 14: 336-50(1971). (In Russian).

Male mice of the C57BL strain were subjected to γ irradiation with ^{60}Co in a dose of 350 or 700 R (dose rate 18 R/min), and a day later to overloads in the amount of 10 units for 30 min (centrifuge). The effect of these factors was studied in an experimental group of animals against a background of the combined injection, 15 to 30 min prior to irradiation, of 75 mg/kg each of cystamine and S,β-aminoethylisothiuronium (AET). It was established that the effect of the overloads one day prior to irradiation decreases radiation damage to the hematopoietic organs, while in the event of such exposure a day after irradiation there was observed an insignificant intensification of radiation depletion of the spleen and bone marrow and an increase of destructive lesions in the peripheral nervous system. Cystamine in conjunction with AET has a radioprotective effect both in the case of irradiation without overloads and in the case of their combined action. In the latter case, nonuniform damage to various divisions of the peripheral nervous system is noted. (JPRS)

15487 ROLE OF BRAIN CORTEX IN THE REGULATION OF BLOOD-BRAIN BARRIER PERMEABILITY TO ^{45}Ca DURING X IRRADIATION IN SMALL DOSES. Dubrovina, T. N. (Inst. of Higher Nerve Activity, Moscow). Dokl. Akad. Nauk SSSR; 199: No. 2, 493-6(11 Jul 1971). (In Russian).

It was previously demonstrated that ionizing radiation affected the penetrability of the blood-brain barrier, but experiments had been based on lethal doses of x radiation. Here, white rats were given total dose of 25 R, and then (after a waiting period of 7 to 30 days) an intraperitoneal injection of 2 μCi of ^{45}Ca that served as an indicator. After 45 min, the animals were sacrificed and samples of blood, cortex, brain stem, and medulla oblongata were analyzed for radioactivity. No difference in blood-brain barrier penetrability was observed between controls and irradiated rats.

In a second set of experiments a dose of histamine dihydrochloride was also administered, but again no difference could be observed. (K.S.W.)

15488 VOPROSY OBSHCHEI RADIOBIOLOGII (EKSPERIMENTAL'NYE I KLINICHESKIE DANNYE). (Problems of General Radiobiology (Experimental and Clinical Data)). Domshlaka, M. P. (ed.). Moscow; Atomizdat (1971). 288p.

This collection of 33 papers by different authors is grouped under seven major topics: sources of radiation and dosimetry, biological activity of various forms of radiation, the effect of the macro-steric distribution of radiation, exposure time, daily variation of the radiosensitivity of animals, post-radiation recuperation, and special observations on the irradiation of man. 553 references. (K.S.W.)

15489 EFFECT OF RADON-ENRICHED AIR ON THE COURSE OF EXPERIMENTAL DERMATITIS. Akimochkina, R. G. Vop. Kurortol., Fizioter. Lech. Fiz. Kul't.; 36: 68-70(1971). (In Russian).

Dermatitis was induced in guinea pigs with 2,4-dinitrochlorobenzene and then exposed to radon-air mixture 20 min each day, arranged so as to preclude inhalation of the mixture. A regression in the infected sites was observed in the test animals which was two to two and one-half times faster than in the control animals. This suggests that a Rn-air bath might be used to treat dermatitis cases. (K.S.W.)

15490 EFFECTS OF DRUGS, ILEAL OBSTRUCTION, AND IRRADIATION ON RAT GASTROINTESTINAL PROPULSION. Summers, Robert W.; Kent, Thomas H.; Osborne, James W. (Univ. of Iowa, Iowa City). Gastroenterology; 59: No. 5, 731-9(Nov 1970).

We studied the transit of a radioactive test solution in the gastrointestinal tract under conditions expected to alter propulsion autonomic drugs, morphine, chlopromazine-induced enteromegaly, indomethacin-induced small intestinal ulceration, ileal obstruction, postirradiation, and fasting. The radioactive test solution was introduced into the stomach or duodenum of rats, and, after a period of time, the stomach and intestines were removed. The distribution of radioactivity was measured by passing the gastrointestinal tract under a scintillation detector and graphically recording the count rate. By comparison of results of intragastric and intraduodenal administration of test solution, variations in gastric emptying were shown to limit the value of studying small intestinal propulsion by intragastric administration of test solution. Mecamylamine, chlorisondamine, and morphine produced significant retardation in propulsion by both techniques. Tolazoline and neostigmine produced acceleration of net propulsion by the intragastric technique, but not by the intraduodenal method. Even though the intestine was dilated after 6 weeks of chlorpromazine treatment, gastrointestinal propulsion was not altered. When ulcers produced by indomethacin did not obstruct the lumen, the test solution passed through the bowel faster than in controls. When the test solution was placed in the stomach of irradiated rats, there was marked gastric retention, but small intestinal transit was markedly accelerated when the solution was put into the duodenum. The intraduodenal technique is not technically difficult and appears to be an improved method for quantification of small intestinal propulsive motility. (auth)

15491 GENETIC EFFECTS OF ACUTE SPERMATOGONIAL X IRRADIATION IN LABORATORY RATS. Chambers, James Robert. Madison, Wis.; Univ. of Wisconsin (1971). 140p. University Microfilms Order No. 71-20,659.

Thesis.

The genetic effects of x-ray exposure of rat spermatogonia were examined in 13,859 first, second, and third (inbred) generation progeny. A single acute 600 R dose and a fractionated 450 R dose (100, 150, and 200 R exposures two weeks apart) were used in two experiments. The objectives of this research were to estimate frequencies of induction of various kinds of mutation, and to measure the effects of mutation on quantitative characters to compare these values with similar estimates from other experiments, primarily those involving rats and mice. Litter sizes in the first and third generations were consistently reduced in irradiated lines. Dominant lethal mutation rate estimates ranged from $(1.18 \pm 1.50) \times 10^{-4}$ to $(3.30 \pm 2.93) \times 10^{-4}$ mutations/gamete/R. These estimates are in the upper range of other estimates obtained in rat and mouse spermatogonial irradiation studies. Estimates of recessive lethal mutation rate based on litter sizes at one day of age ranged from $(8.35 \pm 7.64) \times 10^{-4}$ to $(9.08 \pm 3.33) \times 10^{-4}$ mutations/gamete/R. These are about five times higher than rates obtained in other studies involving rats and mice. Due to peculiarities of the method of estimating the recessive lethal mutation frequencies, lethality caused by induced reciprocal translocations was suspected to have inflated these values. Inconsistency between experiments for effects on 21-day litter sizes suggests that later measurements are unreliable indicators of irradiation damage. Segregation patterns of marker genes in F_2 progeny were tested for distortion in an attempt to estimate radiation induced autosomal recessive lethals. Regions of the genome surrounding marker genes were scanned for these effects; However, variation in marker gene segregation appeared to be too large to allow detection of irradiation effects in the populations examined. Analysis of sex ratios failed to detect radiation induced reduction of overall male proportions; however, intra-strain examinations showed results in the purebred Cu_2 strain to be consistent with those obtained by Taylor and Chapman (1969) whereas results from crossbreds appeared to conflict with those from purebreds. The reason for this is unknown. Specific locus mutation rate estimates were attempted. The efficiency of the method was reduced by a generation delay in making the test cross. No mutations were observed. One visible mutant discovered in the irradiated line in the third generation was presumed at first to be an autosomal recessive mutation. Its phenotypic features and the apparent semi-sterility of female relatives implied that a reciprocal translocation was a more probable cause. Twenty-one day body weights and two subsequent body weight gains were analyzed for irradiation effects. No consistent net influence was observed. Changes in the design of the experiments are proposed for further research having the present objectives. It is concluded from these results that there is still no real evidence of differences between rats and mice with respect to the genetic effects of spermatogonial x irradiation. (Diss. Abstr. Int., B)

15492 VARIATION OF CYTOCHROME C PEROXIDASE ACTIVITY IN THE PRESENCE OF IRRADIATED AND RADIOSENSITIZED TISSUES. Dinescu, G.; Mihai, G. Rev. Roum. Biochim.; 8: No. 1, 39-45(1971).

Some biochemical changes induced by irradiation under radiosensitizing conditions in normal rat tissues and Jensen sarcomas were studied; tumor radiosensitization was performed by local tumor irradiation under conditions of low pH and catalase inhibition. The results show the following: in vitro irradiation of tumor homogenates at pH = 6 leads to an increased damaging effect of H_2O_2 formed during irradiation (in comparison with physiological pH); estimation was done by determining the amount of cytochrome c decomposed under the action of H_2O_2, which is 70% higher in solutions irradiated at pH = 6 than at pH = 7.4. Association of irradiation with a catalase inhibitor (AT) results in an increase in the cytochrome c peroxidase activity in the presence of brain and spleen homogenates from treated animals. Jensen sarcomas irradiated in vivo under radiosensitizing conditions show a slight decrease in succinoxidase activity and cytochrome c stability towards H_2O_2, compared with irradiated control tumors. (Rom. Sci. Abstr.)

15493 INTRARENAL VASCULAR ALTERATIONS IN RADIATION NEPHRITIS AND THEIR RELATIONSHIP TO THE DEVELOPMENT OF HYPERTENSION. Ljungqvist, Arne; Unge, Gunnar; Lagergren, Curt; Notter, Gustav (Karolinska sjukhuset, Stockholm). Acta Pathol. Microbiol. Scand., Sect. A; 79: 629-38(1971).

Unilateral radiation nephritis was induced in 20 rats. This regularly resulted in the development of hypertension, but only after removal of the non-irradiated kidney. The increase in blood pressure was unrelated to uraemia. The irradiated kidneys showed typical micro-angiographic alterations consisting in a reduction of the cortical vasculature, whereas the medullary vasculature was well visualized. These alterations were ascribed to glomerular lesions induced by the irradiation. Renal arteriosclerosis was mild or absent. The juxtaglomerular cell granulation was increased in the non-irradiated kidney early after irradiation, and tended to return to normal levels by prolongation of the interval from irradiation to removal of the non-irradiated kidney. It is suggested that: the non-irradiated kidney exerts a protective action on the blood pressure level in unilateral radiation nephritis; the development of hypertension after removal of the non-irradiated kidney is due to an altered vascular pattern in the irradiated kidney resulting in a relative cortical ischaemia; and the radiation causes an acute damage of the juxtaglomerular cells, which, in the present experiments, was reversible. (auth)

15494 ALTERATION OF THROMBOCYTE AGGREGATION CAUSED BY SEROTONIN AND ADP IN ACUTE RADIATION SICKNESS. Dorofeev, V. M.; Zyablitskii, V. M.; Nestaiko, G. V. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 72: No. 11, 32-4(Nov 1971). (In Russian).

Aggregation of rabbit thrombocytes was induced by ADP and serotonin and the effect of 600 R radiation on the stability of the aggregates was observed on the first, seventh, and fifteenth days after irradiation. It was thought that the disturbed aggregation following the introduction of serotonin was associated with a reduced number of qualitative changes in 5-OT receptors. (H.L.W.)

15495 COMPARATIVE STUDIES ON THE PROPERTIES OF VARIOLA VIRUS STRAINS. II. PATHOGENICITY FOR SUCKLING MICE AND GAMMA-IRRADIATED ADULT WHITE MICE. Shafikova, R. A.; Marennikova, S. S. (Research Inst. of Viral Preparations, Moscow). Acta Virol. (Prague) Engl. Ed.; 15: No. 4, 321-3(Jul 1971).

Differences in the pathogenicity of variola virus strains for suckling white mice and irradiated adult white mice were found. There was a certain correlation between virulence of the strains and the severity of disease: strains isolated from haemorrhagic smallpox were the most virulent and those from varioloid the least virulent. The possibility of using 1 month old white mice after total gamma-irradiation to evaluate pathogenicity of variola virus strains was demonstrated. (auth)

15496 METABOLIC ALTERATIONS INDUCED BY γ-IRRADIATION AND THE EFFECTS OF CYSTEINE AND OF PCF_3 PRODUCT. NOTE III. Tanase, Ioana; Strungaru, Alexandra; Gheorghe, N.; Ciontescu, Lelia (Institut de Physiologie Normale et Pathologique, Bucharest). Rev. Roum. Physiol.; 8: No. 4, 333-43(1971). (In French).

Gamma irradiation (1000 rads) modified the molecular state of the brain in rats. The x-ray examination indicated an abnormal crystalline arrangement and frequency modifications were recorded by infrared spectra. The stereochemistry of the macropolymer functions of the brain seemed to be disturbed. It is thought that radiation produced a steric molecular symmetry characteristic of nerve tissue. The occurrence was noted of selective and specific metabolic alterations in sulfhydryl groups, ketoacids, nonsaturated fatty acids, esterified fatty acids, nonesterified fatty acids, choline phosphatides, and purine and pyrimidine bases. Cysteine and PCF_3 product were used as radioprotective agents. (H.L.W.)

15497 INFLUENCE OF ADRENERGIC RECEPTOR-INHIBITORS ON THE EFFECTIVENESS OF RADIOPROTECTIVE SUBSTANCES. Langendorff, H.; Langendorff, M. (Heiligenberg Inst., Ger.). Experientia; 27: No. 11, 1303-4(15 Nov 1971). (In German).

The beta adrenergic receptor-inhibitors, phentolamin and propanolol, were injected intraperitoneally into mice prior to administration of the radioprotective substances, AET, cystamine, lipopolysaccharide of Escherichia coli, serotonin, and trianisyl-2-chlorethylene. The mice were x-irradiated in doses of 750 to 1120 R. The results showed that the receptor-inhibitors significantly reduced the effect of the protective substances. (H.L.W.)

15498 DNA SYNTHETIC RESPONSE OF ADOPTIVELY TRANSFERRED THYMOCYTES IN THE SPLEENS OF LETHALLY IRRADIATED MICE. I. EFFECTS OF VARYING ANTIGEN AND THYMOCYTE DOSES. Gershon, Richard K.; Hencin, Ronald S. (Yale Univ., New Haven). J. Immunol.; 107: No. 6, 1723-8(Dec 1971).

The DNA synthetic response of adoptively transferred thymocytes was measured in the spleens of lethally irradiated syngeneic mice by determining the uptake of ^{125}I-labeled 5-iodo-2-deoxyuridine. Sheep red blood cells (SRBC) were used as a source of antigenic stimulation and the effects of varying both the antigen (100-fold range) dose and the thymocyte (50-fold range) dose were studied. The shape of the thymocyte response curve was similar to that of thymus-derived lymphocytes responding in radiation chimeras. At all thymocyte doses studied the largest antigen dose (0.2 ml of packed SRBC) produced the best response. With this antigen dose, no significant variation in peak response was seen over a 10-fold thymocyte dose range although the peak occurred earlier with the highest thymocyte dose. These results suggest that this technique is useful for studying the response of thymocytes to antigen and that the response itself is a complex one. (auth)

15499 EFFECTS OF X IRRADIATION, DIETHYLSTILBESTROL, AND SIZE AT TIME OF RELEASE ON THE EARLY SEXUAL MATURATION OF COHO SALMON ONCORHYNCHUS KISUTCH. Lorz, Harold William. Corvallis, Oreg.; Oregon State Univ. (1971). 108p. University Microfilms Order No. 71-25,068.

Thesis.

Precocious male coho are of limited economic value and control of their numbers returning to the hatchery or the increased survival of full-sized adults would be beneficial. Factors influencing early sexual maturation and attempts to suppress this maturation of males through the incorporation of a hormone in the diet, treatment of parr with x-irradiation and control of the size at time of release by manipulation of the food were investigated. The investigation was carried out at the Fish Commission of Oregon's Big Creek Hatchery from June 1964 to January 1967 using the 1963 and 1964 broods of coho. A portion of the treated animals of the 1963 brood was retained through adult maturation in fresh water at Big Creek and a similar group was held in salt water at Bowmans Bay, Washington. Fish in one production pond received diethylstilbestrol incorporated into the Oregon Moist Pellet diet at 200 μg/g from November 1964 through April 1965. Juvenile coho that received the various exposures of x-irradiation were taken to Corvallis for treatment and then returned to Big Creek. An experiment involving manipulation of diet to achieve two distinct sizes of smolts was initiated in April 1965 and carried through to March 1966, at which time the smolts were released. Juvenile coho salmon that received the hormone in their diet produced only half as many precocious males as the control when reared in fresh and saltwater ponds and only one quarter as many precocious males when released to the ocean. The adult survival for the two groups was equal in the ponds although only 30% of the hormone group was recovered at the hatchery as compared to the control. No long term effects on the viability of the gametes was noted but the mean length of fish in the hormone group was significantly smaller than that of the control fish. X-irradiation of parr did not inhibit early sexual maturation. No long term effects on the viability of gametes was noted. X-irradiation is not a practical tool for suppression of gonad development because juvenile coho have a low tolerance. (Diss. Abstr.)

15500 REPTILIAN RADIOBIOLOGY. Cosgrove, G. E. (Oak Ridge National Lab., Tenn.). J. Amer. Vet. Med. Ass.; 159: No. 11, 1678-84(1 Dec 1971).

Approximate median lethal dosages (LD_{50}) for several species of reptiles are presented, ranging from 300 to 400 R for snakes to 1,030 R for box turtles. The principal lethal damage seems to be to the hematopoietic system, but changes are much more gradual and prolonged than in mammalian systems, necessitating the use of a 90-day period for snakes and 120 days for turtles for study of acute radiation mortality. Other uses of reptiles in radiobiology are reviewed and include radioactive environment monitoring, radiation effects on reptilian embryos, gonadal and breeding effects, and use of tracer radioisotopes. (auth)

15501 SKIN HOMOGRAFTS: TOLEROGENIC VERSUS IMMUNOGENIC INFLUENCES IN MICE. Wachtel, Stephen Shoel. (Philadelphia; Univ. of Pennsylvania (1971). 62p. University Microfilms Order No. 71-26,100.

Thesis.

Experiments were performed to compare the survival of infant and adult skin homografts from parental strain and F_1 hybrid donors on normal and immunosuppressed adult mice. Adult mice were exposed to various sublethal doses of whole body x-irradiation just prior to receipt of either adult or newborn skin grafts. Similar grafts on untreated animals provided controls. In strain combinations involving multiple non-H-2 disparities, neonatal skin grafts sometimes survived significantly longer than adult grafts of the same genetic constitution on normal adult hosts, and almost invariably outlived grafts of adult origin on immunosuppressed recipients. Moreover, newborn transplants of long standing often rendered their hosts unresponsive to adult skin grafts from the same donor strain. With some H-2 compatible strain combinations in which homozygous neonatal grafts were rejected, F_1 hybrid (heterozygous) grafts of similar age not only survived indefinitely, but induced tolerance of subsequent adult parental strain homografts as well. These tolerogenic and gene dosage effects, although much weaker, were likewise revealed with H-2 incompatible neonatal skin grafts. It was concluded that neonatal skin homografts are both immunogenic and tolerogenic, and that, when weak histoincompatibilities exist, the tolerogenic influence prevails. After considering certain parallels in the immunologic behavior of embryonic or neonatal and neoplastic tissues, it was suggested that topographical differences between neonatal and adult cell membranes might account for their antigenic disparity. (Diss. Abstr.)

15502 MEASUREMENT OF RADIATION EFFECTS ON THYROID CELL DNA SYNTHESIS USING TRITIATED THYMIDINE. Greig, William R. (Royal Infirmary, Glasgow). pp 105-21 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

A detailed study was made on the effects of different doses of x irradiation on the thyroid cell population of the normal rat and on the cell population during goitrogenic growth. The techniques employed included sequential measurement of total thyroid weight, cell density, cell composition, and RNA and DNA synthesis using chemical methods and cell labeling following the administration of ^3H-thymidine. The data are critically discussed with emphasis on how to use the rat thyroid as a radiobiological model with which to

study radiation effects on proliferation of differentiated thyroid cells in vivo and DNA synthesis. (C.H.)

15503 RESPONSE OF NERVE TISSUES OF ADRENAL GLANDS OF MONKEYS TO X RADIATION. Agarkov, G. B. (Inst. of Zoology, Kiev). Vestn. Zool.; No. 4, 81-3(1969). (In Russian).

Monkeys (Macacus rhesus) were given whole-body x radiation (1000 R) administered in 2 to 3 R doses over a period of one year. Examination of the nerve tissues of the adrenal glands revealed hypertrophy, vacuolization, and other structural changes. The significance of these changes in relation to radiation disease of the adrenal glands is discussed. (H.L.W.)

15504 EFFECTS OF 1-(2-DIMETHYLAMINOETHYL)-CYCLOHEPTIMIDAZOL-2(1H)-ONE ON THE RADIOSENSITIVITY OF THE HEMOPOIETIC SYSTEM IN MICE. Ueno, Yori (Kyoto Univ.). Arzneim.-Forsch.; 21: No. 8, 1212-14(1971).

The modification of the effect of γ radiation on the reproductive integrity of the endogenous spleen colony (ESC) forming cells in mice by 1-(2-dimethylaminoethyl)cycloheptimidazol-2(1H)-one was reported. The chemical agent enhanced the radiation effect when 25 mg was injected i.p. 150 min prior to irradiation, whereas it reduced the effect when injected 15 min prior to irradiation. Thus, it was presented that the agent gave two reverse actions, radiosensitizing and radioprotecting to the hemopoietic system, depending on the time interval between the administration and the irradiation. (auth)

15505 REPOPULATION OF THYMUS, SPLEEN, AND BONE-MARROW OF IRRADIATED AKR MICE INJECTED WITH NORMAL OR IRRADIATED BONE-MARROW CELLS. Leonard, A.; Decleve, A.; Maisin, J. R. (CEN-SCK, Mol, Belgium). Experientia; 27: No. 10, 1212-14(15 Oct 1971).

Irradiated AKR/TlAld mice were injected intravenously within one hr after irradiation with bone marrow cells from either non-irradiated or irradiated AKR mice. When irradiated AKR mice served as donor, bone marrow cells were taken immediately after irradiation. All recipients and the irradiated donors were given a whole-body dose of 650 R of x rays. Nonirradiated AKR donor cells injected into AKR/TlAld recipients were able to proliferate and represented a large percentage of the total cell population in the thymus, spleen, and bone marrow 6 days after injection. Irradiated AKR donor cells, proliferating in an irradiated recipient, constituted a much smaller percentage of the cell population, particularly in the bone marrow and thymus. (H.L.W.)

Invertebrates

Refer also to abstract 15414.

15506 (COO-2001-6) GENETIC EFFECTS OF LOW X-RAY DOSES IN DROSOPHILA. Comprehensive Report, December 1, 1968-August 15, 1971. Abrahamson, Seymour (Wisconsin Univ., Madison). Contract AT(11-1)-2001. 45p. Dep. NTIS.

A large-scale experiment is described for investigating the mutation frequency-dose kinetics in oogonia of adult Drosophila melanogaster females for very low x-ray doses ranging from 20 to 500 R. Young adult females were treated with x rays and the frequency of newly arisen X chromosome lethals in their offspring was determined. A breeding scheme for detecting sex-linked lethals is described and the frequency of sex-linked lethals in the F_2 generation was determined. Results of experiments do not support the hypothesis of other investigators that very low doses of x rays have a several-fold higher potential for mutagenicity than can be expected on linear extrapolation from work with higher doses. This effect was reported by earlier investigators for doses of 55 to 162 R given to spermatogonia in early developmental stages, but not for 300 R. Results of present experiments, obtained from irradiation of oogonia with 20 and 100 R, seem to show the opposite trend. (H.L.W.)

15507 (IA-1237) EFFECT OF DOSE RATE ON THE RADIATION SENSITIVITY OF THE WAREHOUSE PEST CALLOSOBRUCHUS MACULATUS F. Naharin, A.; Calderon, M.; Kott, Y. (Israel Atomic Energy Commission, Tel Aviv). Sep 1971. 11p. Dep. NTIS (U. S. Sales Only).

The effect of different dose rates on the sensitivity to γ radiation of the three stages (egg, larva, pupa) of the warehouse pest Callosobruchus maculatus was studied. The experiments were carried out for nine dose rates within the range 750 to 900,000 rads/h with the LD_{50} as a sensitivity criterion. A radiation dose rate effect was found in all stages after a certain dose rate threshold was reached which was specific to each stage of development. In the egg the threshold occurred at 6000 rads/h, in the larva at 12,000 rads/h, and in the pupa at 130,000 rads/h. (auth)

15508 FURTHER INVESTIGATIONS ON THE USE OF IRRADIATED EGGS TO DEVELOP IMMUNITY AGAINST ASCARIDIA GALLI IN CHICKENS. Deo, P. G.; Sokolic, A.; Rao, Gangadhara Y. V. B. Indian Veterinary Research Inst., Izatnagar). Brit. Vet. J.; 127: 430-5(1971).

Double vaccination of chickens at 20 and 50 days of age with irradiated eggs of Ascaridia galli resulted in a strong immunity to challenges at 80 days and thereafter. Of the two radiation doses used (10 kR and 15 kR) the latter appeared to give the more effective protection. In neither case did male worms develop from the vaccine. This is epidemiologically an important factor in controlling the spread of infection from the vaccinated birds. Vaccinated birds had better growth rates than non-vaccinated controls subjected to the same challenges. Further studies on immunity against A. galli infections and on the radiobiology of this helminth are in progress. (auth) (UK)

15509 COMPARATIVE EFFECTS OF ^{60}Co γ-RAYS AND 29 MeV ELECTRONS ON ARTEMIA. Iwasaki, T.; Maruyama, T. (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol.; 20: No. 5, 493-6(1971).

Experiments were made to compare the effect of 29 MeV electrons and ^{60}Co γ rays on the hatching time of Artemia eggs, and on the subsequent mitosis in the nauplii. The dry eggs were exposed at a depth of 2 cm in a water phantom. The hatching delay increased linearly with the dose over a range of 0 to 250 krads, for both 29 MeV electrons and ^{60}Co γ rays. In the nauplii examined 10 hrs after hatching, the number of mitotic cells decreased at a dose of 50 krads, then increased from 100 to 200 krads, and beyond this dose decreased again. Percentages of prophase, metaphase and ana-telophase nuclei in the newly hatched larvae were plotted against dose. It was concluded that with this response also, there was no significant difference between the effects of 29 MeV electrons and ^{60}Co γ rays. (UK)

15510 DOSE-RESPONSE KINETICS OF GENETIC EFFECTS INDUCED BY 250-kVp X RAYS AND 0.68-MeV NEUTRONS IN MATURE SPERM OF DROSOPHILA MELANOGASTER. Gonzalez, Frank William. Madison, Wis.; Univ. of Wisconsin (1971). 98p. University Microfilms Order No. 71-25,189.

Thesis.

Mature sperm, sampled from Drosophila melanogaster males that were irradiated with several doses of 0.68 MeV neutrons or 250-kVp x rays, were tested for the presence of translocations, sex-linked recessive lethal mutations, and dominant lethal mutations. The data support the conclusions that: neutrons induce all of these effects by the action of single proton tracks. Some x-ray-induced translocations and dominant lethals induced by x rays are produced by single electron tracks while the remainder are produced by at least two tracks. X-ray-induced recessive lethal mutations are produced by single electron tracks. It was also concluded that the theories of Neary and of Rossi and Kellerer could adequately account for greater effectiveness of neutrons than x rays in inducing all three effects. (Diss. Abstr. Int., B)

15511 EXCEPTIONAL MOLTING OF RHODNIUS PROLIXUS CAUSED BY IRRADIATIONS APPLIED AT VARIOUS TIMES DURING POSTEMBRYONIC DEVELOPMENT. Pinet, J.-M.; Hamouda, M. Habib Ben (Institut National Agronomique, Paris). Compt. Rend., Ser. D; 273: No. 15, 1314-17(11 Oct 1971). (In French).

Systematic irradiation at every pupal stage in the development of Rhodnius established the effect of γ radiation on the molting mechanism. Certain insects were observed to molt without prior feeding, a stimulus normally necessary for this phenomenon to occur. It is possible that ionizing radiations act directly upon the neurosecretory cells; this would explain the effect observed (appearance of supernumerary giant pupae, effect on vitellogenesis). (France)

15512 EFFECTS OF X IRRADIATION ON THE TOXICITY OF ORGANOPHOSPHATE INSECTICIDES TO THE HOUSE FLY (MUSCA DOMESTICA L.). Drake, John Leland. Tucson, Ariz.; Univ. of Arizona (1971). 93p. University Microfilms Order No. 71-23,897.

Thesis.

Dosage-mortality tests for 30 organophosphate insecticides and one carbamate insecticide applied to the house fly were conducted during this study. Twenty of the organophosphate insecticides had no significant change in their toxicity levels between male and female control and x-irradiated flies. X-irradiation induced significant changes in toxicity for 10 of the insecticides. Three basic results were observed: increased toxicity, decreased toxicity, and no change in toxicity. These results agree with the findings of previous studies. Seven of the insecticides exhibited significant toxicity changes between control and irradiated male and control and irradiated female flies, indicating a probable sex factor in

house fly response to these chemicals. Electrophoretic analysis of control and irradiated male and female house fly homogenates on polyacrylamide disc gels indicated no qualitative differences in the banding patterns for general proteins, α-naphthyl esterases, and alkaline phosphatases. There appeared to be quantitative differences in some bands between male and female control and x-irradiated fly homogenates. However, protein standards were not run and the size and intensity changes noted may be due to differences in total protein mass between fly populations or to quantitative changes in the enzymes themselves. Penetration and storage effects on organophosphate insecticide toxicity to the house fly are considered. If these two factors were responsible for the toxicity changes observed in this study, it would be expected that all dosage-mortality curves would have shifted in one direction, which was not the case. A model for enzyme induction and repression modified to fit higher cells is discussed as a possible mechanism for the toxicity changes observed. The discussion of this model is necessarily simple and speculative. (Diss. Abstr.)

15513 CHANGES IN SURVIVAL AND TOLERANCE LEVELS IN A RADIATION-RESISTANT STRAIN OF AEDES AEGYPTI (DIPTERA: CULICIDAE) DURING 90 GENERATIONS. Stahler, Nathan (Naval Medical Research Inst., Bethesda, Md.). Ann. Entomol. Soc. Amer.; 64: No. 6, 1247-9(15 Nov 1971).

A radiation-resistant strain of Aedes aegypti (L.) was mass-selected by exposing eggs to a dosage of 2500 R of γ radiation. The adult emergence rates for 90 generations showed that, as fitness declined, radiation resistance increased in two discrete steps. The result was a radiation-induced mortality of about 30% in the resistant strain, as compared to 93% in the control. (auth)

15514 OOGRAM PATTERN FROM MICE EXPOSED TO IR-RADIATED CERCARIAE OF SCHISTOSOMA MANSONI. Oliveria, Daisy; Katz, Naftale; Pellegrino, J. (Univ. Federal, Minas Gerais, Brazil, Instituto Nacional de Endemias Rurais, Belo Horizonte, Brazil). J. Parasitol.; 57: No. 5, 1139-40(Oct 1971).

Mice were inoculated subcutaneously with cercariae exposed to 1000, 2500, and 5000 R doses of gamma radiation. Control mice were inoculated with nonirradiated cercariae. The mice were killed seven weeks later and the schistosomes in the liver and mesenteric vessels were collected by perfusion. The oogram pattern (percentage of viable eggs in different stages of maturation and of dead eggs and shells) was determined. No schistosomes were found in the mice exposed to cercariae exposed to 5000 R. Only 14 sterile worms were recovered from the mice exposed to 2500 R and 47 worms were recovered from the mice exposed to 1000 R. The oogram of the latter group showed an increase of dead eggs and a decrease of viable eggs. (H.L.W.)

Radionuclide Effects (Internal Source)

Refer also to abstracts 15460 and 16763.

15515 RADIOBIOLOGY OF THE IRRADIATED LEUKOCYTE. V. PROTEOLYTIC ACTIVITY AND MICROELEMENT LEVELS. Turcu, Gr.; Dimoftache, C. (Inst. of Medicine and Pharmacy, Bucharest). Rev. Roum. Biochim.; 8: No. 3, 279-84(1971).

The parameters determined were the proteolytic activity of PMN leukocytes from Wistar rats submitted to 1 and 2 μC/g ^{32}P internal β irradiations and the level of the microelements Zn, Cu, and Mn in the same cells and under identical irradiation conditions. The proteolytic activity was estimated as an expression of the extinction determined at 290 nm for the whole leukocytes and the homogenate and supernatant of lysed leukocytes. As regards the microelements the technique of neutron activation was used and ^{64}Cu, ^{69}Zn and ^{65}Mn levels were read. The results show a maximum diminution in the proteolytic activity of leukocytes the 12th day of internal irradiation and a decreasing tendency of Zn, Cu and Mn amounts in leukocytes of irradiated animals, the most prominent one appearing in the case of Mn. (auth)

Man

15516 RADIATION DOSE TO BRAIN FROM AN ORAL THERAPEUTIC DOSE OF RADIO-IODINE (^{131}I). Gupta, P. C. (INMAS, Delhi). Indian J. Radiol.; 22: No. 4, 223-8(1968).

The radiation dose to brain tissue during the first few h after administration of an oral dose of radioiodine (^{131}I) was estimated, considering all the main compartments that could contribute to the dose. The effect on the dose of different rates of uptake as between normal and hyperthyroid states was also investigated. (Indian Sci. Abstr.)

15517 LATE INJURIES AFTER ^{224}Ra INJECTION IN MAN. Spiess, H. (Univ., Munich); Mays, C. W. Monatsschr. Kinderheilk.; 118: No. 6, 224-6(1970). (In German).

Radium-224 injections were given to 891 patients between 1946 and 1951. Late effects were studied and data on the following are presented: minimum skeletal dose, relation between radiation dose and frequency of sarcomas, effects of age and sex on frequency of sarcomas, and chromosomal defects. No malformations developed in first generation offspring. (INIS)

Animals

Refer also to abstract 15177.

15518 (LA-DC-13083) BIOLOGICAL IMPLICATIONS OF THE TRANSURANIUM ELEMENTS FOR MAN. Langham, Wright H. (Los Alamos Scientific Lab., N. Mex.). [1971]. 32p. (CONF-710919-4). Dep. NTIS.

From eleventh symposium on the biological implications of the transuranium elements; Richland, Wash. (27 Sep 1971).

Data on the annual production rate of ^{238}Pu and ^{239}Pu for use in medical and space programs are projected to the year 2000. The biological implications of Pu accumulation in man and his environment are considered. The Pu protection programs initiated by the USAEC, Canada, and the UK in 1949 are reviewed. Recommendations of the ICRP (1951) of 0.04 μCi as the maximum permissible amount of ^{239}Pu fixed in the human body, with maximum air and water concentrations derived accordingly, are reported. Data accumulated since 1950 from studies on the long-term chronic toxicity of inhaled, injected, and ingested Pu in animals are discussed. Recommendations for research studies on Pu inhalation and Pu transport through soil-plant-man food chains to ensure continued protection of man against the hazards from environmental Pu are included. (C.H.)

15519 (TID-25891) FALLOUT RADIATION EFFECTS ON LIVESTOCK (PART A) AND FIELD CROPS (PART B). Annual Report, November 1, 1969-October 31, 1970. Bell, M. C.; Sasser, L. B.; West, J. L.; Wade, L. Jr.; Killion, D. D.; Constantin, M. J. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Contract AT-40-1-GEN-242. 35p. Dep. NTIS.

Cattle ingesting ^{90}Y-labeled fallout simulant at the rate of 2 mCi/kg of body weight were more severely affected than those given 57,000 rads β radiation to 8% of the dorsal body surface. Whole-body γ irradiation of 240 R from ^{60}Co at 1 R/min affected only blood platelets and leukocytes. When these three treatments were combined on eight steers all died within 54 days. Cattle were more sensitive to simulated fallout radiation than sheep. Major damage from ingested radioactivity was in the rumen and abomasum of both species with the injury and dosimeter readings much greater in the rumen of cattle than in sheep. Skin irradiation alone was not lethal to cattle but the 40-week-weight gain was reduced by 50% in comparison with controls. Preliminary data on 44- to 88-μ-^{90}Y sand fed to sheep indicate that results are similar but not as severe as those obtained with 88- to 175-μ-^{90}Y sand. The effects of the γ radiation component of radioactive fallout on plants of rice (Oryza sativa), winter barley (Hordeum vulgare), winter wheat (Triticum vulgare), corn (Zea mays), and soybeans (Glycine max) were investigated. Primary emphasis was placed on the influence of growth stage of the plant when irradiated, total exposure dose, and exposure rate on survival, growth, and seed yield. The results showed that a single value cannot be assigned as being representative of the tolerance of any crop to γ irradiation, because many factors are inherent to plants, their environment, and the mode of exposure to ionizing radiation that modify the extent of damage incurred. The order of tolerances to γ irradiation was found to be barley ≤ wheat < corn < soybeans < rice. Generally, plants were most sensitive during early seedling stages and during meiosis (initial reproductive stages). Irradiation of a plant after pollination and fertilization required relatively high exposures to reduce seed yield. (C.H.)

15520 EVALUATION OF TUMOR INCIDENCE FOLLOWING EXPOSURE TO INTERNAL EMITTERS BY APPLICATION OF THE LOGISTIC DOSE-RESPONSE SURFACE. Rosenblatt, L. S.; Hetherington, N. H.; Goldman, M.; Bustad, L. K. (Univ. of California, Davis). Health Phys.; 21: No. 6, 869-75(Dec 1971).

A modification of an actuarial life expectancy table was used to derive cumulative incidence rates for osteosarcoma in 43 beagles injected with ^{226}Ra at dose levels between 0.1 and 10 μCi ^{226}Ra/kg. Logistic (growth) curves of the form $E = M\,(1 + \exp(a - bt)^{-1})$ were used to fit these data, using a finite difference equation with unit t intervals. (E is the cumulative tumor incidence at time t and M is the maximum incidence; a is a measure of the animals reserves combatting intrinsic and extrinsic factors leading to non-survival and b is the measure of difference between rate constants for damage and recovery). It is suggested that the nonlinear three dimensional surface (response, dose and time)

could be of use in extrapolating radiation effects to low-dose areas, particularly where the data covers a wide dose range. (UK)

15521 RADIOSENSITIVE TISSUE IN BONE. Loutit, J. F.; Vaughan, J. M. (Medical Research Councin, Harwell, Eng.). Brit. J. Radiol.; 44: No. 526, 815(Oct 1971).

A brief review is made of the papers published since 1968 concerning tissues at risk of malignant transformation from the deposition of radioactive material in bone. Particular reference is made to work with murine radiation chimaeras and normal mice, each given 20 μCi ^{90}Sr, and subsequent observations of tumor yield. It is concluded that it may be advisable when considering radiation dose to bone and bone marrow from external radiation or emitters of hard β and x rays in bone, to recognize malignant transformation of reticuloendothelial and supporting tissues as well as those in hemopoietic and osteogenic tissues. (UK)

15522 TOXICITY OF ^{125}IUdR IN CULTURED MOUSE BP8 TUMOUR CELLS. Porteous, D. D. (Strangeways Research Lab., Cambridge, Eng.). Brit. J. Cancer; 25: No. 3, 594-7 (Sep 1971).

The radiation damage from low-energy electrons emitted by β particles from ^{125}I in labeled iododeoxyuridine (^{125}IUdR) was assayed by labeling the DNA of BP8 mouse tumor cells with the nucleoside and studying their subsequent growth in culture. Injury was observed in cells grown in medium containing more than 0.01 μCi/ml. The amount of label incorporated into cells showing deleterious effects is compared with that reported by others. (auth)

Plants

15523 (CONF-710501-46) EFFECTS OF SIMULATED FALLOUT RADIATION ON REPRODUCTIVE CAPACITY OF FESCUE. Dahlman, Roger C.; Beauchamp, John J. (Oak Ridge National Lab., Tenn.); Tanaka, Yasuomi (Tennessee Univ., Knoxville. Dept. of Forestry). [1971]. 35p. Dep. NTIS.

From third national symposium on radioecology; Oak Ridge, Tenn. (10 May 1971).

The effect of chronic irradiation (<17 rads/day) on the reproductive potential of tall fescue (Festuca arundinacea Shreb.) grass was investigated for a fescue community contaminated with ^{137}Cs fallout simulant. Internal daily dose rate to apical meristems from radioactivity in tissue was calculated as 4.3 rads β and 0.3 rads γ per day at the beginning of vegetative phenophase with an additional measured external exposure of 12 rads/day. By the end of first-year flowering, when the internal dose rate to meristematic tissues had decreased by a factor of 10 and total dose rate ranged from 11 to 17 rads/day, seed production was reduced approximately 50% relative to controls. At the conclusion of the second season, when dose rate had decreased by 40% and radioactivity concentration in tissue had decreased by a factor of 200 to 300, seed production was 20% less than controls. The number of germinable seeds per panicle, measured by seed germination, was not significantly reduced in either reproductive period. Diminished reproductive capacity indicates that floral organ initiation and development may be significantly affected by low-intensity simulated fallout radiation. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 15193.

15524 (BNWL-SA-4077) PLUTONIUM IN AUTOPSY TISSUE SAMPLES. Nelson, I. C.; Heid, K. R.; Fuqua, P. A.; Mahony, T. D. (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1971. Contract AT(45-1)-1830. 40p. (CONF-710919-6). Dep. NTIS.

From eleventh symposium on the biological implications of the transuranium elements; Richland, Wash. (27 Sep 1971).

Tissue samples have been obtained at autopsy from former plutonium workers, other employees and residents in the environs of the Hanford Atomic Project since 1949. These samples, which included lung, liver, bone, sometimes tracheobronchial lymph nodes, and occasionally other tissue samples, were analyzed radiochemically for plutonium. Data obtained since 1965 and a recapitulation of results since 1949 are presented. A discussion of these results relative to plutonium work exposure and plutonium from worldwide fallout is also presented. (auth)

15525 (EUR-4700) LEVELS OF RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT AND THE FOOD CHAIN. Annual Report, 1970. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 8 Jun 1971. 56p. (In French). Dep. NTIS (U. S. Sales Only). EUR FF 7,75.

During 1970 the EURATOM-CEA Association continued its work on the radioactive contamination of the environment and the food chain. Its research on the factors transferring contamination sources to man, begun in 1969, was intensified, as well as the study of the problems presented by contamination associated with radioactive contamination. In the field of human biology, work on the metabolism of strontium and its retention in the skeleton has reached the stage of data interpretation and the study of a model. Work on the transfer of atmosphere contamination of plants via wet media is now approaching completion and the relating to the transfer of ruthenium, cobalt and zinc from continental waters is in a very advanced stage. The problems arising from chemical contamination associated with radioactive contamination were studied together with fluorine and its compounds. Lastly in the field of synthetic studies, an attempt has been made to assess the risk of internal contamination of man by the radioactive pollution of water. (auth)

15526 (KFK-EXT-23/71-1) SURVEILLANCE OF TRITIUM INCORPORATION AT THE KARLSRUHE NUCLEAR RESEARCH CENTER DURING THE YEARS 1967 TO 1970. Schieferdecker, Horst (Kernforschungszentrum, Karlsruhe (West Germany)). Sep 1971. 19p. (CONF-710809-11). Dep. NTIS (U. S. Sales Only).

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

Surveillance is reported of tritium incorporation in personnel of nuclear reactors at the Karlsruhe Nuclear Research Center. The results of radiometric analyses of urine samples are converted to body doses by a desk computer for which a specific program was developed. The dose results obtained during the years 1967 to 1970 are reported. A distinct increase in the internal body doses was observed with increasing tritium content of the heavy water. The method used for urine analysis is described.

15527 (UCRL-20850) PLUTONIUM IN MAN: A TWENTY-FIVE YEAR REVIEW. Durbin, Patricia W. (California Univ., Berkeley. Donner Lab.). Jun 1971. Contract W-7405-eng-48. 141p. Dep. NTIS.

Urinalysis was the method chosen to monitor internal Pu contamination of the chemists who separated the first batch of reactor-produced Pu in late 1943, and it is still the only way of detecting exposure to ^{239}Pu. In order to determine the relationships between urinary excretion and body Pu content, 18 persons (15 over the age of 45) were injected in 1945 and 1946 with tracer doses of ^{239}Pu. The original data are collected and critically reviewed and reanalyzed. (auth)

15528 RADIATION DOSES RECEIVED BY WORKERS USING TRITIUM IN INDUSTRY. Lambert, B. E.; Vennart, J. (Radiological Protection Service, Belmont, Eng.). Health Phys.; 22: No. 1, 23-30(Jan 1972).

Measurements of tritium in the body water (e.g., urine) of workers using tritiated luminous compound have been made at the Radiological Protection Service (RPS) since early 1963, when the material first became available, and of industrial users of tritium gas from about 1965. Results showed that environmental control alone has not prevented the intake of tritium by workers. Radiological control therefore, necessitates continuous biological monitoring of workers for tritium in urine. The results of this monitoring are presented and show that the radiation doses received by some workers are not inconsiderable. The accuracy of estimates of dose depended on the interval between successive samples of urine and the uncertainty concerning the half period of tritium in the body. Practical cases are discussed with reference to these parameters. For estimations of dose under conditions of chronic intake of significant activities of tritium it was concluded that monitoring must be done at intervals so short that they may not be considered practicable. The alternative was to organize the working conditions so that intake of significant activities was unlikely and biological monitoring was then used solely as a check that good conditions were maintained. (auth)

15529 EFFECT OF NATURAL FACTORS ON ^{137}Cs ACCUMULATION IN THE BODIES OF RESIDENTS IN SOME GEOGRAPHICAL REGIONS. Marei, A. N. (Inst. of Biological Physics, Moscow); Barkhudarov, R. M.; Novikova, N. J.; (and others). Health Phys.; 22: No. 1, 9-15(Jan 1972).

Results are presented of the first stage of an investigation intended to identify regions with high ^{137}Cs content in the bodies of inhabitants due to stratospheric fallout; to establish distribution curves of accumulation levels of incidence of this isotope in

various age groups of the population, and to determine the sources and characteristics of ^{137}Cs transport to the human body. During three years, studies were conducted in a territory with an area of more than 100,000 km^2 where the ^{137}Cs content in the human body ranged between 10^{-8} and 10^{-7} Ci/body. No essential differences were observed in the ^{137}Cs concentration in children and adults. The main source of ^{137}Cs in the diet was milk, where concentrations of this isotope reached 2000 pCi/l, and to a lesser degree meat, vegetables, and fish. Contamination of these foodstuffs was due to intensive migration of ^{137}Cs from soil, though its concentrations there did not usually exceed those observed in the flat country of middle latitudes in the Northern hemisphere. Increased ^{137}Cs migration from soil probably resulted from the structure, mineral content, and chemical composition, and acidity of the soil. The constants of ^{137}Cs transfer from soil to grass increased from 2.5 to 32.6 depending on the type and characteristics of the soil. (auth)

15530 TOXICITY CLASSIFICATION OF NATURAL THORIUM AND NATURAL URANIUM. Duggan, M. J. (Radiological Protection Service, Belmont, Eng.). Health Phys.; 22: No. 1, 102-3 (Jan 1972).

It is pointed out that there is danger in the I.A.E.A. classification of toxicity, derived from the ICRP report of Committee 2 which lists radionuclides according to the value of MPC_a. It is considered that because the dose due to a given intake is independent of the duration of intake, the toxicity classification to be derived is equally valid for single or continuous intake. This would result in natural thorium (Th-nat) and natural uranium (U-nat) being in the lowest toxicity group, although considerations of MPC_a alone would place them in the highest group. The MPC_a of Th-nat and U-nat expressed in terms of mass per unit volume of air were very small compared with the dust loadings found in many practical situations. (UK)

15531 CASE OF ACCIDENTAL ASPIRATION OF $^{90}SrCl_2$. Petkau, A.; Pleskach, S. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Health Phys.; 22: No. 1, 87-90(Jan 1972).

Thirteen days following probable ingestion of $^{90}SrCl_2$, a 23 year old healthy male submitted an overnight urine sample, which, when analyzed for gross β contamination, showed a level of activity equivalent to 1483 dis/min/day. No measurable amount of bremsstrahlung radiation was detected with a whole body counter capable of determining a minimum amount of 0.1 μCi. The urinary and fecal excretory pattern was subsequently determined for 803 and 790 days respectively, and plasma levels were followed for 40 days. The half-life of 347 days for the long duration term of the urinary excretion rate was compared with other published values. A linear regression analysis indicated a correlation (0.72) between the half-life of the long duration term and the age of the subject at the measurement time. (UK)

Animals

Refer also to abstracts 14692 and 15209.

15532 (FOA-4-4473) RESIDUAL RADIOACTIVITY ON PASTURE AVAILABLE FOR COWS AFTER A PREVIOUS SHORT GRAZING PERIOD. Auraldsson, Hans-Ake; Ekman, Lars; Eriksson, Ake; Greitz, Ulf (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1971. 6p. Dep. NTIS (U. S. Sales Only).

The fraction of initially deposited ^{131}I and ^{85}Sr available for grazing cows on a previously completely grazed area was estimated. About five weeks after the first grazing experiment on a pasture with residual radioactivity the cows were brought there for another three-day grazing period and after that were brought to uncontaminated pastures. The radioactivity in the milk was measured for 15 days. All activity data were corrected for decay. It was found that the maximum concentration of ^{131}I and ^{85}Sr in milk at the second experiment was 5.3 and 4.0 per cent respectively of the values obtained in the initial experiment. During the same time period the activity in the grass had decreased to 5.2 and 3.9 per cent. The percentage decrease in milk (and grass) is about the same for strontium and iodine. (auth)(Sweden)

15533 (UCRL-73116(Rev.1)) TRITIATION OF AQUATIC ANIMALS IN AN EXPERIMENTAL MARINE POOL. Harrison, Florence L.; Koranda, John J.; Tucker, John S. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Dec 1971. 36p. (CONF-710809-13). Dep. NTIS.

From Tritium symposium; Las Vegas, Nev. (30 Aug 1971).

Tritiated water was added to a 2000-gallon seawater pool containing clams (Mya arenaria), crabs (cancer productus), and fishes (Gillichthys mirabilis). The concentration of tritium (T) was followed for six months in the pool water, in the body water of the animals, and in the organic material of the tissues. During the experimental period the levels of tritiated water in the pool decreased gradually from 1.7×10^5 to 5.0×10^4 disintegrations per minute per milliliter due to the replacement of evaporated water with nontritiated water. In the body water of the animals, T increased rapidly to about 95% of the T level in the seawater and remained at about that level for the duration of the experiment. In all the animals T was incorporated slowly into the organic matter of the tissues. The maximum specific activity (T/H) observed in the organically bound T of the tissues was less than 50% of that in the seawater. (auth)

15534 PERCUTANEOUS ABSORPTION BY RATS OF TRITIUM FROM A LUMINOUS COMPOUND. Rehnberg, B. F.; Moghissi, A. A.; Wheeler, J. K.; Colvin, M. C. (Southeastern Radiological Health Lab., Montgomery, Ala.). Health Phys.; 22: No. 1, 31-4(Jan 1972).

Percutaneous absorption of tritium from a luminous compound by rats was experimentally determined. The effects of routine and thorough washing, the latter determined by u.v. monitoring, were studied. The excretion of the absorbed tritium followed a two compartment exponential function. In addition to the biological half-life equal to that of tritiated water, a shorter biological half-life was observed. (UK)

15535 RADIOBERYLLIUM METABOLISM BY THE DAIRY COW. Mullen, A. L.; Stanley, R. E.; Lloyd, S. R.; Moghissi, A. A. (Southwestern Radiological Health Lab., Las Vegas, Nev.). Health Phys.; 22: No. 1, 17-22(Jan 1972).

A single oral dose of radioberyllium was administered to each of 4 cows to measure the transfer of radioberyllium to milk. Less than 0.002% of the ingested activity was recovered in the milk. The biological half-time as measured in the milk was 19 hr. In this study, radioactive beryllium presented less radiological health hazard than the other commonly released radionuclides. In a companion study, 1 lactating dairy cow was administered a single intravenous dose of radioberyllium and three calves were each given a single oral administration. The animals were sacrificed at various time intervals and samples collected for tissue distribution studies. The liver, kidney and skeletal system were found to accumulate most of the absorbed activity. The bone appeared to be the site of long-term deposition. (UK)

15536 INFLUENCE OF PRUSSIAN BLUE ON METABOLISM OF ^{137}Cs AND ^{86}Rb IN RATS. Stather, John W. (National Radiological Protection Board, Harwell, Eng.). Health Phys.; 22: No. 1, 1-8(Jan 1972).

Prussian Blue (P.B.) has been shown to bind ^{137}Cs in the lumen of the mammalian gut forming a stable complex and thus increasing the faecal loss of ^{137}Cs from the body. The effect of P.B., provided in drinking water, on the excretion of intraperitoneally (I.P.) administered ^{137}Cs from rats of various ages, was investigated. In 19 week old rats, the body burden of ^{137}Cs was reduced to 34% of the controls at 1 week after injection, whilst in 9- and 4-week old animals, the corresponding values were 28 and 9% respectively. Analysis of tissues suggested that the main limiting factor governing the rate of excretion of ^{137}Cs during P.B. therapy was the turnover rate of ^{137}Cs in muscle tissue. The turnover rate declined with increasing age and this was reflected by a decreasing efficiency of the P.B. in removing ^{137}Cs from the animal. Rubidium-86 had a similar distribution in the rat to ^{137}Cs, but a faster turnover rate in muscle tissue. Following i.p. administration of ^{86}Rb to 11 week old rats, P. B. treatment reduced the whole body biological half-time of retention of this radionuclide from 10.3 days to 1.7 days, resulting in the body content of ^{86}Rb being reduced to 9% of the controls at 7 days after injection. It was demonstrated that P.B. could be successfully used to reduce the body content of ^{137}Cs fed chronically to rats. (UK)

15537 ^{226}Ra IN ENVIRONMENTAL MATERIALS AND FOODS. De Bortoli, M.; Gaglione, P. (EURATOM, Ispra, Italy). Health Phys.; 22: No. 1, 43-8(Jan 1972).

In the frame of the site radiation monitoring program at the Euratom Research Establishment at Ispra, Italy, the natural levels of ^{226}Ra in some environmental materials and in the population diet were studied. Determinations of the radionuclide were carried out, by the emanation technique, on samples of vegetation, milk, animal bones, lake waters, fishes and foods, in an attempt to estimate the ^{226}Ra intake by the population living in the area. Another purpose of this study was that of gaining information about the transfer of radium through the different environmental chains, and to compare the behavior of radium with that of calcium. The mean ^{226}Ra concentration in the soil was 0.72 pCi/g, and the estimated daily intake by a person consuming foods of local origin was 1.4 pCi of ^{226}Ra, or 2.8 pCi/g Ca. (UK)

15538 METABOLISM OF ^{203}Hg ADMINISTERED AS $HgCl_2$ IN THE DAIRY COW AND CALF. Potter, G. D.; McIntyre, D. R.; Vattuone, G. M. (Univ. of California, Livermore). Health Phys.; 22: No. 1, 103-6(Jan 1972).

Mercury-203 was administered orally as $HgCl_2$ to two lactating cows (344 μCi each) and one calf (490 μCi). The cows were maintained in a metabolic stall for 144 hrs and the calf for 42 hrs. In the cows, peak concentrations of ^{203}Hg were reached between 24 and 48 hrs. After 48 hrs, fecal levels dropped and the other levels remained relatively constant. The total fecal output of ingested ^{203}Hg was approximately 95%. About 0.05% of the administered dose was excreted in urine and 0.01% in milk. The biological half-life was 28.5 hrs. The urinary levels reflected those of the plasma, but the concentrations on erythrocytes were approximately twice that of plasma. In the calf, the radiomercury was principally concentrated in the following tissues in decreasing order of concentration: kidneys, liver erythrocytes, lungs, and spleen. Recovery in calf tissue at 42 to 48 hrs was 0.229%, in the cow 0.98%. In the same period, 0.097% was secreted in the milk. (UK)

15539 COMPARISON BETWEEN THE BIOLOGICAL HALF-LIFE OF A TRITIATED LUMINOUS COMPOUND WITH THAT OF TRITIATED WATER IN RATS AND CATS. Wheeler, J. K.; Moghissi, A. A.; Rehnberg, B. F.; Colvin, M. C. (Eastern Environmental Radiation Lab., Montgomery, Ala.). Health Phys.; 22: No. 1, 35-8(Jan 1972).

A single oral dose of a tritiated luminous compound in common usage by the luminous dial painting industry was given to rats and cats, and the tritium concentration followed in the urine, feces, and various body tissues. A major fraction of the absorbed tritium was eliminated with a biological half-life essentially the same as that of tritiated water. (auth)

15540 STUDIES ON SHORT-LIVED INTERNAL α EMITTERS IN MICE AND RATS. PART II. ^{227}Th. Mueller, Walter A. (Gesellschaft fuer Strahlen- und Umweltsforschung mbH, Munich). Int. J. Radiat. Biol.; 20: No. 3, 233-43(1971).

Thorium-227 is an interesting model for a short-lived bone surface-seeker with α-emission. The distribution after intraperitoneal injection of ^{227}Th-citrate in the different organs is described. About 70% of the injected Th was retained in the skeleton. The total dose burden depends to a high degree on distribution of decay products, especially ^{223}Ra. Calculations were made for the skeletal dose in mice. They gave 200 rads per 1 μCi of ^{227}Th injected. The highest skeletal dose-rate (7 rads/day per 1 μCi/kg) was reached at the third day after injection. The possibility of bone sarcoma induction is discussed by comparison with dose relationships after incorporation of ^{228}Th. A provisional mechanical technique is described for estimation of the activity of bone surface and volume separately. (auth)

15541 INGESTED SOIL AS A SOURCE OF MICROELEMENTS FOR GRAZING ANIMALS. Healy, W. B. (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.); McCabe, W. J.; Wilson, G. F. N. Z. J. Agr. Res.; 13: No. 3, 503-21(Aug 1970).

Two sheep were drenched each with 100 g of soil containing approximately 1 mc each of ^{60}Co, ^{54}Mn, ^{75}Se, and ^{65}Zn. Activities of these isotopes in blood, urine, and feces were monitored at intervals over a 10-day period by gamma-ray spectroscopy. At the end of this period the animals were killed and a range of hard and soft tissue samples was taken for analysis. From the data obtained on blood and tissue samples taken at time of death, and from urine samples over the 10-day period, amounts of isotopes absorbed by the animals and amounts of isotopes originally held on the ingested soil were compared. The amounts of the isotopes absorbed by the animals from the soil, expressed as a percentage of an isotope held on the soil, were approximately: ^{75}Se, 34%; ^{65}Zn, 14%; ^{60}Co, 1%; ^{54}Mn, 0.4%. (auth)

15542 COMBINED USE OF ION-EXCHANGE RESINS AND OSMOTIC DIURESIS FOR THE DECREASE OF ^{85}Sr CONCENTRATION IN THE ORGANISM. Nikolov, I.; Bokova, N.; Kiradzhiev, G. Rentgenol. Radiol.; 9: No. 2, 87-92(1970). (In Bulgarian).

The problem of the rapid elimination of radioactive isotopes from the organism has been the subject of intensive research work. The binding of radioactive substances in the gastrointestinal tract before their absorption and transport via the blood and lymph is of major importance for the lowering of their concentration in the tissues and organs. Investigations were carried out with rats receiving per os ^{85}Sr and treated with ion-exchange resins (Dowex-50Wx2, Amberlit-IRC-50) and mannitol. The preparations were given alone or in combination at varying intervals after the application of the radioactive substance. Superior results were obtained with the isolated use of ion-exchange resins administered 10 and 30 min after strontium. In using these preparations in combination with mannitol (to induce osmotic diuresis) the effectiveness of decorporation was reduced. The use of mannitol alone failed to reduce ^{85}Sr adsorption. The effective period of half-elimination was shortened in the interval from 2 to 72 h with the isolated use of ion-exchange resins. (INIS)

15543 NEGATIVELY CHARGED AEROSOLS. EFFECT ON PULMONARY CLEARANCE OF INHALED $^{239}PuO_2$ IN RATS. Wehner, A. P. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Chest (Chicago); 60: No. 5, 468-71(Nov 1971).

Four-month-old female albino rats received a single 15 to 20 min nose-only exposure to $^{239}PuO_2$ dust (CMD 0.3 μm). The animals were then randomly divided into experimental and control groups of 10, 12, and 18 rats each for three exploratory experiments. In experiments 1 and 2, the experimental rats were treated $3\frac{1}{2}$ hr daily with negatively charged electro-aerosol (1% NaCl solution dispersed by a Küster-Barthel type aerosol generator, jet potential—26 kV, MMD of aerosol particles 3.8 μm) and killed after three weeks. In experiment 3, the experimental rats were treated continuously with electro-aerosol and killed in groups of six after 5, 24, and 48 hr respectively. After death, the lungs were removed and analyzed for ^{239}Pu. With the exception of the subgroup killed after 24 hr, the mean lung burden of ^{239}Pu was from 8 to 34% lower in the animals treated with electro-aerosol than in the controls treated with uncharged aerosol and those not treated with aerosol. (auth)

15544 FALLOUT ^{137}Cs IN CLAMS (RANGIA CUNEATA) FROM THE NEUSE RIVER ESTUARY, NORTH CAROLINA. Wolfe, Douglas A. (National Marine Fisheries Service, Beaufort, N. C.). Limnol. Oceanogr.; 16: No. 5, 797-805(Sep 1971).

The concentration of ^{137}Cs from fallout was determined for the soft tissues of clams (Rangia cuneata) from the Trent-Neuse estuary during 1965 to 1967. The ^{137}Cs concentration in Rangia varied inversely as a logarithmic function of salinity in the estuary, but with a lesser salinity dependence than reported previously for ^{137}Cs concentration factors in Rangia. An increasing concentration gradient of ^{137}Cs with increasing salinity in the estuary was therefore hypothesized and was confirmed by analysis of ^{137}Cs in estuarine water of varying salinity. Transport of ^{137}Cs on sediments into estuaries, coupled with ion-exchange displacement of ^{137}Cs from the sediments at elevated salinities, is proposed to explain the concentration gradient of ^{137}Cs in the estuary. (auth)

15545 EFFECT OF DIANTIPYRILMETHANE ON THE DISTRIBUTION OF THORIUM IN WHITE RAT ORGANS. Pidemskii, E. P.; Sakharnaya, T. Ya. Izv. Estestvennonauch. Inst. Perm. Gos. Univ.; 14: No. 10, 103-6(1970). (In Russian).

Rats were injected intraperitoneally with $Th(NO_3)$ once or once a week for seven weeks (single dose 100 mg/kg). Some of the animals were also injected with diantipyrilmethane. The Th content in the spleen was higher than in the liver and it was four to five times higher after a single injection than after repeated injections. The Th concentration of the blood was virtually equal to the control. (JPRS)

15546 ACCUMULATION OF RADIOISOTOPES BY DEVELOPING ROE OF TENCH (TINCA TINCA L.) AND PERCH (PERCA FLUVIATILIS L.). Kulikov, N. V.; Bezel, V. S.; Ozhegov, L. N. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Ecology (USSR) (Engl. Transl.); No. 5, 425-8(Sep-Oct 1970).

Translated from Ekologiya; No. 5, 73-7(Sep-Oct 1970).

The accumulation of ^{144}Ce, ^{106}Ru, ^{95}Zr, and ^{137}Cs in the roe of fresh-water fishes was studied. It was shown that they are accumulated more intensively in tench roe than in perch roe. When the water temperature is lowered, the rate of accumulation of radioisotopes decreases, while the length of the incubation period decreases. Calculation formulas are cited, along with the summary doses of irradiation of roe developing in aqueous solutions of radioisotopes with a concentration of 10^{-5} Ci/liter, calculated according to them. (auth)

Plants

Refer also to abstract 15537.

15547 PLUTONIUM IN LICHEN COMMUNITIES OF THE THULE, GREENLAND REGION DURING THE SUMMER OF 1968. Hanson, W. C. (Battelle Memorial Inst., Richland, Wash.). Health Phys.; 22: No. 1, 39-42(Jan 1972).

Modest amounts of ^{239}Pu, ^{240}Pu attributable to the January 1968 aircraft accident near Thule, Greenland were found in lichens collected near that site during July–August 1968. It was mostly associated with particles of estimated 0.5–1.0 μ diameter that contained slightly greater than background levels of plutonium radioactivity. (UK)

15548 REGULATION OF THE MICRONUTRIENT STATUS OF PLANTS BY CHELATING AGENTS AND OTHER FACTORS. Wallace, Arthur. Los Angeles; Arthur Wallace (1971). 319p. (UCLA-34P-51-33).

Radioisotope studies are discussed in the following chapters: effects of micronutrient and DTPA applications on ^{241}Am and micronutrient contents of soybeans; ^{59}Fe uptake by soybeans; uptake and distribution of ^{185}W and ^{110}Ag in plants; ratio of iron to chelating agent absorbed by plants as measured by ^{59}Fe and ^{14}C tracers; effect of EDTA on transport of ^{59}Fe in bush bean plants from an application of $^{59}FeEDDHA$; ^{65}Zn and ^{54}Mn uptake by bush beans; retranslocation of ^{241}Am in bush beans; effect of citrus rootstock and chelating agent on specific activity of iron and zinc in shoots of grafted plants and on ^{59}Fe, ^{65}Zn, ^{210}Pb, and ^{241}Am contents in shoots; ^{32}P and ^{59}Fe distribution base-rooted vs leaf-rooted rough lemon leaves; and specific activities of iron and zinc in plants when ^{59}Fe and ^{65}Zn have been equilibrated with soil. An additional 69 chapters are included on various aspects of plant nutrition. (H.L.W.)

15549 ROLE OF FRESHWATER VEGETATION IN PROCESSES OF MIGRATION AND DISTRIBUTION OF NATURAL RADIOACTIVE ELEMENTS IN THE RESERVOIR. Iskra, A. A.; Kulikov, N. V.; Bakhurov, V. G. (Inst. of Ecology of Plants and Animals, Sverdlovsk, USSR). Ecology (USSR) (Engl. Transl.); No. 2, 157-62(Mar-Apr 1970).

Translated from Ekologiya; No. 2, 83-9(Mar-Apr 1970).

The accumulation of uranium-238, radium-226, and thorium-232 by various representatives of water vegetation was studied under experimental conditions. Coefficients of accumulation and concentration of these elements are presented for 27 plant species. Data on the distribution of the radioactive elements in the basic components of model systems of a reservoir are set forth. (auth)

15550 ENTRY OF ^{91}Y INTO PLANTS THROUGH THE LEAF SURFACE. Chebotina, M. Ya. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Ecology (USSR) (Engl. Transl.); No. 4, 350-2(Jul-Aug 1970).

Translated from Ekologiya; No. 4, 97-9(Jul-Aug 1970).

The transport of ionic and complexed ^{91}Y from the foliage to other plant parts was studied. Yttrium-91-labeled EDTA or $^{91}YCl_3$ was administered to pea seedlings and 25 days later the leaves, stems, cotyledons, and roots were separated from the plant and the radioactivity was determined. The tabulated results show that most of the ^{91}Y was retained at the site of introduction. Movement from the foliage to other plant parts was less than 5%. The movement of ^{91}Y-EDTA was approximately seven times greater than that of $^{91}YCl_3$. A comparison of results with studies of other investigators showed that there was a greater migration ability of ^{60}Co and ^{59}Fe following application to the leaves. (H.L.W.)

15551 ROLE OF FRESHWATER PLANTS IN PROCESSES OF COPRECIPITATION OF ^{90}Sr WITH CALCIUM CARBONATE. Kulikov, N. V.; Lyubimova, S. A.; Timofeeva, N. A. (Inst. of Plant and Animal Ecology, Sverdlovsk, USSR). Ecology (USSR) Engl. Transl.); No. 4, 315-17(Jul-Aug 1970).

Translated from Ekologiya; No. 4, 55-8(Jul-Aug 1970).

It was established that strontium-90 is incorporated together with calcium into carbonate compounds, formed in the water as a result of the vital activity of plants. During the transfer of these elements to the carbonate deposit, there is a discrimination of strontium-90 relative to calcium with a discrimination coefficient of 0.3. It is suggested that the process of carbonate formation occurs on the surface of the plants. (auth)

15552 DIRECT CONTAMINATION OF BARLEY WITH ^{51}Cr, ^{59}Fe, ^{58}Co, ^{65}Zn, ^{203}Hg, AND ^{210}Pb. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe). Radiat. Bot.; 11: No. 6, 463-72(Dec 1971).

A study was made of barley sprayed at six different stages of development with ^{51}Cr, ^{59}Fe, ^{58}Co, ^{65}Zn, ^{203}Hg, and ^{210}Pb. The initial retention was calculated as a function of $IR = 1 - e^{-0.2lg/cm}$, the dry weight of the herbage in a plot in grammes, and cm the height of the plants at spraying. The field loss depended on the growing rate and the development of the plants and thus varied throughout the growing period. If the whole growing season is considered, the loss of activity in per cent is about equal to the time in days from the spraying to harvest. Zinc-65 and ^{58}Co showed the highest concentrations in the grain. The translocation of ^{51}Cr, ^{210}Pb and ^{203}Hg within the plant was small. ^{59}Fe was translocated to the grain as was ^{65}Zn, but to a far less extent. (auth) (UK)

New Tracer Techniques

Refer also to abstract 14776.

15553 (COO-1089-16) AN INVESTIGATION CONCERNING THE VALIDITY OF THIN SUBSTRATE FILM TECHNIQUES FOR THE HISTOCHEMICAL DETECTION OF RIBONUCLEASE ACTIVITY. NEGATIVE RADIOAUTOGRAPHIC LOCALIZATION OF RIBONUCLEODEPOLYMERASE ACTIVITIES BY THE USE OF ^{14}C LABELED RNA, TRITIUM LABELED RNA, AND TRITIUM LABELED SYNTHETIC POLYRIBONUCLEOTIDES INCORPORATED INTO THIN SUBSTRATE FILMS. Woolfrey, Bertram F. (Minnesota Univ., Minneapolis). [1971]. Contract AT(11-1)-1089. 205p. Dep. NTIS.

Thesis.

A radioisotope tracer method for the histochemical localization of enzyme activity was developed that uses negative autoradiography and thin substrate films incorporating ^{14}C-RNA, ^{3}H-RNA, and ^{3}H-synthetic polyribonucleotides. The end point of the method depends on the enzymatic breakdown of the substrate with the subsequent loss of the radioisotopically labeled portions of the substrate. Detection is therefore specific for substrate altered by enzyme activity. Applications in the detection of ribonuclease activity are reported in detail. It is postulated that the method could be used for other enzymes. (509 references) (C.H.)

15554 (COO-1762-7) [GROWTH OF UTERINE, PLACENTAL, AND FETAL VASCULATURE]. (Colorado Univ., Denver, Medical Center). [1970]. 45p. Dep. NTIS.

A method for measuring the magnitude and distribution of uterine blood flow in pregnant mammals at various times during the gestation period is described. Plastic microspheres of several sizes labeled with ^{141}Ce or ^{51}Cr are injected intravenously into pregnant animals and the pregnant uterus is removed at various times following injection of the tracer. Data from radiometric analysis of tissue homogenates are used to measure total blood flow and blood flow in various tissues. Results are reported from measurements in pregnant sheep of blood circulation in the uterus, placental tissues, and cerebral blood flow in fetuses. The method will be used to measure uterine blood distribution in pregnant Rhesus monkeys and the effects of various hormones on the magnitude and distribution of uterine blood flow in pregnant sheep and monkeys. (C.H.)

15555 DIAGNOSIS OF LEFT UPPER QUADRANT MASSES BY MULTIPLE ORGAN SCANS. Samuels, Larry D. (Ohio State Univ., Columbus). Surg. Gynecol. Obstet.; 133: No. 6, 963-6 (Dec 1971).

Combined spleen-liver and kidney scans can provide a preoperative differential diagnosis of left upper quadrant parasplenic masses. Frequently, the scan images are definitive enough to eliminate an operation. The commonest example of this is the palpably-large spleen or the enlarged left lobe of the liver. Parasplenic metastatic malignant lesions or cysts, adrenal neuroblastoma on the left side, or Wilms' tumor on the left side can usually be distinguished on multiple organ scans, and the surgeon can, thus, be prepared preoperatively for the special demands of each type of tumor. (auth)

15556 AUTOMATED RADIOMETRIC DETECTION OF BACTERIA IN 2,967 BLOOD CULTURES. DeBlanc, Harold J. Jr.; DeLand, Frank; Wagner, Henry N. Jr. (John Hopkins Medical Institutions, Baltimore). Appl. Microbiol.; 22: No. 5, 846-9 (Nov 1971).

A new radiometric method for the automatic detection of bacterial growth in blood cultures was compared with conventional methods. A total of 2,967 cultures from 1,280 patients suspected of having bacteremia were studied. A 2-ml amount of blood was inoculated into culture media in which the glucose was labeled with carbon-14. The release of $^{14}CO_2$ by bacterial metabolism was checked hourly for 18 to 24 hr, daily for the next 2 days, and, on the 12th day, with an automated instrument. A 10-ml amount of blood was studied by conventional bacteriological techniques. In 125 cultures from 50 patients, there was bacterial growth in at least one of the routine media. Of these, the radiometric method detected 102 cultures from 40 patients. In 111 cultures from 48 patients, there was radiometric detection of bacterial growth. In all of these cultures, there was detection of bacterial growth in subcultures from the radioactive medium. Of these, the routine laboratory detected 98 cultures from 40 patients. Neither method detected all patients with bacteremia. Among the 57 patients positive by one or both methods, routine techniques detected bacteria in 87% and the radiometric method detected bacteria in 85%. Seventy per cent of the cultures were detected first by the radiometric method, 65% on the day of inoculation. Our results suggest that the radiometric method is faster than conventional techniques and comparable in accuracy. Its great advantage is that it is simple, automatic, and can be extended to automatic detection of bacterial sensitivity to antibiotics. (auth)

15557 FURTHER MODIFICATION OF A TECHNIQUE FOR RADIOMMUNOASSAY OF INSULIN. Wilson, R. B. (Massachusetts Inst. of Tech., Cambridge); Martin, J. M. Can. J. Comp. Med.; 35: No. 4, 298-300(Oct 1971).

An immunoassay procedure reported previously [Wilson and Martin, Can. J. Comp. Med., 33: 264-270(1969)] was modified to increase the sensitivity and reproducibility of the assay. The differences between the present procedure and the previous one are: an initial 20 hr incubation period before the addition of the tracer insulin, and incubation at 37°C instead of 4°C. The adapted method resulted in standard curves of similar slope for bovine, porcine, rhesus monkey, canine, and human insulin. The validity of the assay for bovine insulin was established by recovery and dilution experiments. (auth)

15558 STUDIES ON CHOLESTEROL METABOLISM BY APPLICATION OF HEAVY WATER AND MASS SPECTROMETRY AND BIOLOGICAL EFFECTS OF HEAVY WATER IN RATS. Peng, Shikaung. Evanston, Ill.; Northwestern Univ. (1971). 212p. University Microfilms Order No. 71-30,913.

Thesis.

A new technique for studying cholesterol metabolism by application of the non-radioactive heavy isotope, D_2O, and mass spectrometry has been developed in this laboratory. Seventy young adult male rats were divided into two groups, one was fed a cholesterol-free diet, the other, a 2% cholesterol diet. The D_2O enrichment of body water of each group was kept at different, but constant, levels (0–15%) by feeding water with a constant percentage of D_2O after injection of a priming dose. Serum, urine and stools were collected at various intervals for a period of 6 months. Subsequently most of the rats were sacrificed, excepting one rat in each group in which the D_2O feeding was discontinued and ordinary water resumed for a period of 3 months before sacrifice. The tissue deuterated cholesterol of 20 rats in different groups was analyzed for a study of the size and dynamics of the body exchangeable cholesterol pool. The studies on symptomatology, gross morphology, hematology and histology of all deuterated rats were utilized for evaluation of the biological effects of D_2O and its safe dose level in mammals. The following results were obtained: There was no significant difference between serum cholesterol levels of rats fed a cholesterol-free diet and those fed a 2% cholesterol diet. In other words, some homeostatic mechanisms in rats operated to keep their serum cholesterol levels within a fairly normal range when they were challenged with a high cholesterol diet. The endogenous cholesterol synthesis of rats fed a 2% cholesterol diet was suppressed by 76% of the average synthetic rate of rats fed a cholesterol-free diet. The fecal excretion of neutral sterols and bile acids of rats fed a 2% cholesterol diet was 2 to 3 times greater than that of rats fed a cholesterol-free diet (88.7 mg/day vs. 32.3 mg/day). The turnover time of body cholesterol of the latter was 2 to 3 times longer than that of the former (20 days vs. 8 days). The intake of cholesterol could be accurately estimated by identification and quantitation of plant steroids in the feces of rats by employing mass spectrometry. The absorption in percentage of cholesterol in rats fed a 2% cholesterol diet was 44% of 184 mg of daily cholesterol intake. For human use, 1–2% of D_2O in the drinking water is recommended. The hazard of irradiation by using radioactive isotopes can be essentially totally circumvented by using this stable nonradioactive isotope. (Diss. Abstr.)

15559 ATTEMPT OF THE EVALUATION OF THE STATE OF OVIDUCTS BY THE DESCENDING TECHNIQUE USING ^{198}Au. Gromadzki, Wojciech; Lukasik, Jerzy; Giedroyc, Bronislaw; Wiskont-Buczkowska, Halina; Kubiak, Arkadiusz (Medical Academy, Danzig). Pol. Med. J.; 10: No. 5, 1262-8(1971).

Colloidal ^{198}Au injections were used for the evaluation of the functional state of the oviducts in cases of sterility or impaired fertility. The descending technique was analyzed and opposed to the routinely used, ascending methods (hysterosalpingography and/or kymographic perturbations) or laparoscopy. The highest conformity was found between the ^{198}Au and laparoscopy. It was found that the ascending route techniques proved to give too optimistic conclusions for diagnosis as well as prognosis or follow-up procedures in certain cases. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 14810, 15067, 15144, 15164, 15565, 15631, 15632, 15653, 15671–15673, 15725, 15745, 15748, 15758, 15786, 15796, 15831, 16431, 16452, 16779, 16821, and 17133.

15560 (ANCR-1001) FABRICATION AND EVALUATION OF SAMPLES FOR THE IRRADIATION PORTION OF THE FBR PHYSICS CONSTANTS PROGRAM. Nisle, R. G. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971. Contract AT(10-1)-1375. 22p. Dep. NTIS.

The contents of both irradiation samples and calibration standards were evaluated by means of measurements of reactivity, neutron activation, and by neutron radiography. The contents of the irradiation samples were found to be as quoted by the manufacturer. The pure absorber samples (lead, aluminum, copper, niobium, and gold) were found to be satisfactory except for the 100% gold sample which was heavily self-shielded. The UO_2–Al samples were found to be unsatisfactory because of uncertainty as to their contents. (auth)

15561 (ANL-7857) FISSION-INDUCED CREEP OF UO_2 AND ITS SIGNIFICANCE TO FUEL-ELEMENT PERFORMANCE. Solomon, A. A.; Routbort, J. L.; Voglewede, J. C. (Argonne National Lab., Ill.). Sep 1971. Contract W-31-109-eng-38. 19p. Dep. NTIS.

A correlation of steady-state creep measurements for UO_2 obtained both in-reactor and out-of-reactor indicates that in-reactor creep has two distinct temperature regimes. Above ~1000°C, normal thermal creep is enhanced when UO_2 is undergoing fission, and an apparent activation energy, which is characteristic of thermal creep in UO_2, is observed. Below 1000°C, however, a creep mechanism that is insensitive to temperature is induced by the fission process. Within experimental scatter, the steady-state creep rates depend linearly on stress and fission rate in both regimes. This correlation is used in the Argonne National Laboratory LIFE-I fuel-element performance code to show that the diametral change of a mixed-oxide fuel element under Experimental Breeder Reactor II conditions can depend sensitively on the fission-induced creep mechanism. The effect of fission-induced and fission-enhanced creep on the stress state developed in the fuel and the Type 316 stainless steel cladding is also determined as a function of burnup. In view of the high tensile stresses generated, the significance of fracture on fuel element performance is also considered. (auth)

15562 (BDX-613-227(Rev.)) BORON SHOT FABRICATION. Final Report. (Bendix Corp., Kansas City, Mo.). Nov 1971. Contract AT(29-1)-613. 78p. Dep. NTIS.

Boron shot of 0.015 ± 0.005 in. diameter was produced in up to 5 g quantities by a shot tower method. Ten- to 100-g charges of molten boron at 3,800 to 4,200°F were pneumatically squirted through 0.007 to 0.015 in. diameter orifices. Problem areas include material compatibility, initiation of streaming, and shot quenching. (auth)

15563 (CONF-680614–, pp 19-25) QUALITATIVE METALLOGRAPHY OF URANIUM–PLUTONIUM MIXED CARBIDE FUELS. Bender, J. H. (Los Alamos Scientific Lab., N. Mex.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A metallographic technique that distinguishes between the metallic, dicarbide, and sesquicarbide phases and precipitates of plutonium silicide in sintered uranium–plutonium carbide fuels is described. This includes general sample preparation, the multiple techniques required, and the interpretation of results. (auth)

15564 (CONF-680614–, pp 26-40) CERAMOGRAPHIC FACILITY AND SPECIAL TECHNIQUES FOR EXAMINATION OF UNIRRADIATED PLUTONIUM–URANIUM CERAMIC FUEL MATERIALS. Smith, F. M.; Olson, R. V. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A glove-box facility for metallographic studies of unirradiated plutonium–uranium ceramic fuels is described. The facility is 22 ft long and about 4 ft wide with an inside height of 30 in. The box is compartmented to minimize the transfer of grit contaminants during different stages of grinding and polishing. Several new metallographic techniques to meet new ceramic research problems are described. They include: compatibility of mixed plutonium–uranium oxide and nitride fuel candidates sodium bonded to 304 stainless steel; transmission electron microscopy of sintered uranium dioxide; etching of plutonium dioxide, plutonium dioxide–uranium dioxide, and plutonium nitride–uranium nitride; replication of unirradiated ceramic fuel materials for electron microscopy; and the examination of Promethium oxide microspheres. (T.F.D.)

15565 (CONF-680614–, pp 81-102) METALLOGRAPHY OF A VARIETY OF UC AND (U,Pu)C MATERIALS. French, P. M.; Hodge, M. H.; Horgos, R. M. (Westinghouse Electric Corp., Cheswick, Pa. Advanced Reactors Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The metallography facility and procedures used for the metallographic preparation of a variety of UC and (U,Pu)C samples are described. UC and (U,Pu)C samples having a wide range of carbon and oxygen contents and also the same materials stabilized either with Fe or $Cr_{23}C_6$ were examined. Compatibility couples, comprising the above carbide materials against a variety of stainless steels and vanadium alloys were also evaluated. The preparation procedures described include mounting, grinding, and polishing as well as chemical, electrolytic, and vacuum cathodic etching of samples for optical microscopy. (auth)

15566 (CONF-680614–, pp 336-49) TECHNIQUES FOR REPLICATING $^{238}PuO_2$ FOR ELECTRON MICROSCOPE STUDIES. Kelly, M. D. (Mound Lab., Miamisburg, Ohio). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Cross-sectioned and polished specimens of plutonium dioxide microspheres have been replicated for electron microscope studies by a technique which produces replicas that are free of radioactive contamination. The microspheres are thoroughly decontaminated by ultrasonic cleansing in ethanol which removes all loose particulates. Proper cleansing of the microspheres and the use of an uncontaminated die prevent contamination of the amber Bakelite resin during mounting. Following metallographic preparation the mount is decontaminated ultrasonically; cellulose acetate tape is softened with acetone and applied firmly to the surface. When the dried tape is stripped from the surface, it retains the particulates which did not adhere to the microsphere surfaces and which contaminate the replica. The radioactive contamination on the replica is determined by alpha counting; then a series of successive replications is made until all loose surface material is removed and the count on the final replica is below the background level. High quality metallographic preparation of the specimen reduces the number of replications required by minimizing "micro-plucking," which results from surface damage. (auth)

15567 (CONF-680614–, pp 350-65) ELECTRON MICROSCOPY INVESTIGATION OF STRUCTURAL FEATURES IN $^{238}PuO_2$. Downs, Gene L.; Braun, Japnell D. (Mound Lab., Miamisburg, Ohio). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A technique for obtaining nonradioactive replicas of plutonium dioxide was developed. The results of observations on freshly prepared, aged, and high temperature annealed microspheres are presented. (auth)

15568 (EUR-4686) EVAPORATION BEHAVIOR OF SAMARIUM AND SAMARIUM DICARBIDE. Hackstein, K.; Nickel, H.; Venet, P. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau (West Germany). Kernforschungsanlage, Juelich (West Germany)). 10 May 1971. 58p. (In German). Dep. NTIS (U. S. Sales Only). EUR DM 5,10.

The vapor pressure of samarium metal and samarium dicarbide was determined using Knudsen's effusion method, the weight loss by the effusion chamber (Knudsen cell) being measured. The vapor pressure of samarium is determined by the equation $\log p_{(mm\ Hg)} = -[(10{,}108 \pm 317)/T_{(°K)}] + 8.23 \pm 0.25$ (1,119°K ≤ T ≤ 1,513°K). Heating samarium carbide to a high temperature in a vacuum results in the decomposition of the carbide into samarium metal and carbon. The relevant vapor pressure equation is $\log p_{(mm\ Hg)} = -[(13{,}146 \pm 838)/T_{(°K)}] + 6.40 \pm 0.50$ 1,420°K ≤ T ≤ 2,025°K, ($SmC_{2.18}$ + 0.35 C bis $SmC_{2.18}$ + 1.49 C). In view of the experimentally derived vapor pressure values, fuel element decontamination appears to be possible simply by means of high-temperature heat treatment. (auth)

15569 (EUR-4697) PRODUCTION, CHARACTERISTICS, AND HYDROLYSIS OF SAMARIUM CARBIDES. Hackstein, K.;

Nickel, H.; Venet, P. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau (West Germany). Kernforschungsaniage, Juelich (West Germany)). 8 Jun 1971. 78p. (In German). Dep. NTIS (U. S. Sales Only). EUR DM 7,30.

The carbothermic reduction of samarium oxide in an inert atmosphere produces carbides of undefined composition. During the reaction the formation of samarium metal and samarium carbide has to compete with, respectively, vaporization or decomposition of the carbide. Carbides produced in a closed tantalum bomb display a defined composition. With the aid of chemical, x-ray, and metallographic examinations, three types of carbide were determined including Sm_3 which is face-centered cubic, of the Fe_4N type. The crystal parameter increases with the carbon content (from a = 5.030 Å for $SmC_{0.27}$ + 0.03 C to a = 5.065 Å for $SmC_{1.14}$ + 0.11 C); in the case of Sm_2C_3, the crystal parameter rises from a = 8.363 Å (for $SmC_{0.90}$ + 0.10 C) to 8.376 Å (for $SmC_{1.37}$ + 0.13 C). The structure of Sm_2C_3 is face-centered cubic, of the Pu_2C_3 type. SmC_2 has a tetragonal face-centered structure, of the CaC_2 type. The difference between the crystal parameters of $SmC_{1.95}$ ± 0.06 (a = 3.768 ± 0.005 Å, c = 6.311 ± 0.005 Å) and $SmC_{2.18}$ ± 0.06 (a = 3.770 ± 0.005 Å, c = 6.334 ± 0.005 Å). Gas chromatograph studies on the gas produced during hydrolysis of the carbides showed that Sm_3C is a methanide, since only hydrogen (79.5 ± 2.1%) and methane (20.5 ± 1.2%) were produced. Sm_2C_3 and SmC_2, on the other hand, are acetylides, since acetyline is the main component (42.0 ± 4.6% in the case of Sm_2C_3; 59.0 ± 0.5% in the case of SmC_2). These results point to the presence of C_2^{2-} groups in the molecules of these carbides. (auth)

15570 (EUR–4713) STUDY OF THE FRICTION-DIFFUSION SAP WELDING PROCESS. Jullien, L.; Savorin, B.; Dumont, C.; Grin, M. (Compagnie pour l'Etude et la Realisation de Combustibles Atomiques, Romans-sur-Isere (France)). 12 Jul 1971. 112p. (In French). Dep. NTIS (U. S. Sales Only). EUR FF 16,60.

The difficulties encountered in the welding of SAP (Sintered Aluminum Powder) led to development of non-conventional techniques for the cladding-plug welding of ORGEL fuel elements. The friction-diffusion technique was one of them and was based on a EURATOM patent. The welding process may be described as follows: A container holds the plug and the cladding close to each other in the center line of the piston of a hydraulic press. This container is heated by eddy currents and the plug is pushed into the cladding, which diameter is smaller than the diameter of the plug. The results show that it is possible to obtain a good welding over 40% of the total length of the plug, corresponding to a mechanical strength of the assembly higher than that of the cladding. Residual deformations appear on the internal side of the plug and may infer an incorrect loading of insulating spacer and fuel pellets. Nevertheless, there are procedures for avoiding this phenomenon. This welding technique offers great possibilities of industrial applications and a summary of the different particular points of possible improvements is given. A description of a hydraulic press specially built for welding of fuel rods under inert gas is included. (auth)

15571 (GEAP–13729) $(Pu,U)O_2$–SODIUM REACTIONS: EFFECT OF FUEL PARAMETERS. Plumlee, D. E.; Novak, P. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Sep 1971. Contract AT(04-3)-189. 95p. Dep. NTIS.

A series of eight sodium-bonded pins and one-gas bonded pin (mixed-oxide fuel) were irradiated in a thermal flux to investigate the thermal performance of sodium-bonded versus gas-bonded fuel and the effect of fuel stoichiometry, density, plutonium content, and burnup on sodium-fuel-cladding interactions. Experimental results indicated that the thermal performance of sodium-bonded fuel is similar to that of gas-bonded fuel. Enhanced fuel volume changes were measured and compared with those of gas-bonded fuel, the rate of change of fuel volume being ≤3.7% ΔV/V/10,000 MWd/Te. Sodium fuel reactivity was observed to decrease with decreasing stoichiometry and plutonium content. Reduced clad attack was observed in sodium-bonded pins compared with gas-bonded pins for similar clad temperatures. (auth)

15572 (HEDL-SA–245) QUANTITATIVE MICROSTRUCTURE AND COMPOSITION ANALYSIS. Carlson, M. C. J. (Hanford Engineering Development Lab., Richland, Wash.). 19 Oct 1971. Contract AT(45-1)-2170. 32p. (CONF-711030–2). Dep. NTIS.

From twenty-fourth Pacific Coast regional meeting of the American Ceramic Society; Anaheim, Calif. (30 Oct 1971).

A description of methods used in measuring radiation effects on fuels is presented. Information is included on measurement scope, porosity characterization, pore frequencies and volume, surface porosity, relations of porosity with physical properties, grain characterization, and composition distributions. (J.R.D.)

15573 (HEDL-SA–270) FABRICATION MICROSTRUCTURE AND THERMAL CONDUCTIVITY IN UO_2–25 WT.PERCENT PuO_2 SINTERED PELLETS. Gibby, R. L.; Lawrence, L. A. (Hanford Engineering Development Lab., Richland, Wash.). Oct 1971. Contract AT(45-1)-2170. 22p. (CONF-711030–3). Dep. NTIS.

From twenty-fourth Pacific Coast regional meeting of the American Ceramic Society; Anaheim, Calif. (30 Oct 1971).

The results of a study are presented which show that thermal conductivity in this system can be significantly affected by the fabrication process. High-pressure-preslugging resulted in sintered mixed-oxide fuels with thermal conductivities lower than those predicted by a thermal conductivity-porosity relationship used for thermal performance analysis. Single-pressed fuels are also varied considerably in microstructure and thermal conductivity with values which ranged from good agreement with the reported thermal conductivity expression to 40% less. Thermal conductivities decreased linearly with increases in the laminar pore density. The pore shape factor β from the modified Maxwell-Eucken relationship increased linearly with laminar pore density from a value of approximately 1 for essentially uniform, isometric pore morphology, to 11 for the observed maximum estimated laminar pore density. The effects of structure on thermal conductivity were confirmed with melting heat rating experiments using single-pressed and high-pressure preslugged fuels. A minimum of 3 to 6% decrease in melting heat rating was observed for a 30% decrease in thermal conductivity due to the presence of laminar, interconnected pores instead of closed, isometric pores. (auth)

15574 (HIT–480) FINAL REPORT FOR PIONEER THERMAL SWITCH EFFORT, JULY 1970–NOVEMBER 1970. (Hittman Associates, Inc., Columbia, Md.). Jan 1971. Contract AT(29-2)-2797. 47p. Dep. NTIS.

Activities in a program to fabricate and test cylindrical sleeves suitable for use as the reentry protection shell for the Pioneer RTG heat source are reported. Three materials were developed and evaluated for this application. They include copper/zirconia rigidized felt, copper/zirconia foam, and copper/magnesia foam. Most of the characterization effort was devoted to evaluation of the two zirconia-based materials. Results are included on sleeve fabrication, property determination, and materials selection. (J.R.D.)

15575 (HIT–488) INTERIM REPORT FOR Ni/ZrO_2 HIGH TEMPERATURE THERMAL SWITCH REPORT, NOVEMBER 1970 TO JANUARY 1971. (Hittman Associates, Inc., Columbia, Md.). Mar 1971. Contract AT(29-2)-2797. 21p. Dep. NTIS.

The High Temperature Metal Thermal Switch Program was redirected back to the design, development, and testing of thermal switch materials for radioisotope thermoelectric generator heat sources operating above 2000°F. The conversion system of interest for this operating temperature is the Isotope-Brayton cycle. The major goal of this preliminary three-month effort was to fabricate thermal switch composite materials and initiate property determination testing. Zirconia (ZrO_2) rigidized felt was selected for the high temperature thermal switch material for consideration for the Brayton cycle heat source. The selection was based on the low thermal conductivity of the rigidized felt structures and the applicable thermal and physical properties of zirconia. A materials survey showed both nickel and palladium metals to have properties suitable for the high temperature thermal switch application. Although nickel was selected for the original development and testing, it appears that palladium would offer some advantages in higher melting temperature, lower vapor pressure and enhanced oxidation resistance. Process development studies on impregnation of the porous zirconia rigidized felt with nickel were conducted and the electroless nickel deposition was selected for the fabrication and testing of nickel/zirconia composites. The original electroless nickel bath composition used a boro-amine reducing agent which left a low boron impurity in the electroless nickel deposit. Such materials have shown substantially depressed melting points. Subsequently, an electroless nickel composition was tested with a hydrazine reducing agent which permitted the deposition of a high purity boron- and phosphorus-free nickel with a melting point close to pure nickel (2650°F). The initial nickel/zirconia composites tested all contained nickel made with the boro-amine and hence had the boron impurity. These tests are continuing, however, additional test specimens are being prepared with a high purity electroless nickel; these materials will be tested during the next phase of the program. (auth)

15576 (LA–4825) ELASTIC MODULI AND THERMAL EXPANSION OF POROUS MOLYBDENUM–URANIUM DIOXIDE CERMETS. Rowley, J. C.; Saunders, C. R.; McInteer, C.; Kempter, C. P.; Riley, R. E. (Los Alamos Scientific Lab., N. Mex.). Nov 1971. Contract W-7405-eng-36. 17p. Dep. NTIS.

Moduli and thermal-expansion data at high temperature were obtained on a series of sintered molybdenum–uranium oxide cermets as part of an investigation aimed at developing models for predicting the mechanical behavior of porous cermet nuclear fuels. The results indicate that the development of models for predicting the creep behavior and thus the fission-product-induced swelling of these cermets will be extremely complex, and that the development of models for such porous cermets will require an extensive experimental program. (auth)

15577 (LA-DC-12794) VARIATION OF LATTICE PARAMETER OF UC–ZrC SOLID SOLUTIONS WITH TEMPERATURE AND COMPOSITION. Bowman, A. L.; Krikorian, N. H.; Nereson, N. G. (Los Alamos Scientific Lab., N. Mex.). [1971]. 12p. (CONF-711033–1). Dep. NTIS.

From third thermal expansion symposium; Corning, N. Y. (27 Oct 1971).

The variation of lattice parameter of uranium carbide–zirconium carbide solid solutions with temperature has been measured by high-temperature neutron diffraction. The cubic lattice parameter was determined from 800 to 2300°C for samples $(U_xZr_{1-x})C$ plus excess carbon, with x from 0 to 0.181. The lattice parameter of all the samples in this composition range can be approximated by the equation $a_t = a_{25}\,(1 + 6.6(3) \times 10^{-6}\,[t - 25] + 0.7(2) \times 10^{-9}\,[t - 25]^2$ from room temperature to 2300°C. (auth)

15578 (ORNL-TM-3577) TRANSMISSION ELECTRON MICROSCOPY OF IRRADIATED BORON CARBIDE. Copeland, G. L.; DuBose, C. K. H.; Donnelly, R. G.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 15p. Dep. NTIS.

Boron carbide powders and a section of a high-density pellet were irradiated at 350 to 400°C to a burnup of about 8% of the ^{10}B (16×10^{20} captures/cm^3). The resulting damage was studied by transmission electron microscopy. Techniques of sample preparation are described. A very high-density uniform black spot damage was observed. The damage appeared to be similar to that observed in metals due to lattice strain after very high fast fluences. There was no evidence of movement or agglomeration of the reaction products. (auth)

15579 ELECTRON PROBE MICROANALYSIS FOR THE DETERMINATION OF EQUILIBRIUM DIAGRAMS. Morlevat, J.-P.; Roussignol, J. (CEN, Grenoble, France). Method. Phys. Anal.; 7: No. 3, 223-8(Sep 1971). (In French).

The important contribution of electron probe microanalysis in the determination of equilibrium diagrams is outlined. Various studies of uranium compounds are described. Special attention is given to quantitative analysis of light elements such as oxygen, carbon, and nitrogen. (France)

15580 TERNARY RARE EARTH BORIDE WITH A $ThCr_2Si_2$-TYPE STRUCTURE. Niihara, Koichi; Shishido, Toetu; Yajima, Seishi (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap.; 44: No. 11, 3214(Nov 1971).

In a study of the phase diagram in the Y–Co–B system, a ternary compound with a tetragonal unit cell was found to have a composition of 19.8% Y, 40.5 % Co, and 39.7 % B (by atomic). The stoichiometric composition of YCo_2B_2 is proposed. The YCo_2B_2 pattern was indexed as tetragonal with unit cell dimensions of a = 3.561 ± 0.003 Å, c = 9.358 Å, and c/a = 2.628. Experimental and theoretical densities were measured to be 6.30 and 6.39 g/cm^3, respectively. The relative intensities were computed assuming that YCo_2B_2 crystallizes isostructurally to the $ThCr_2Si_2$ type, which is an ordered ternary version of the $BaAl_4$ type, the two nonequivalent sites of the Al atoms being occupied by different kinds of atoms. (P.C.H.)

15581 STUDY OF THE INITIAL GROWTH STAGES OF SILICON-MONOXIDE FILMS ON RHENIUM. Shakirova, S. A.; Sokol'skaya, I. L. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 6, 1441-3(Dec 1971).

Translated from Fiz. Tverd. Tela; 13: No. 6, 1723-6(Jun 1971).

A field-emission electron microscope was used to study condensation and growth of dielectric SiO films on Re as a function of the substrate temperature (temperature interval 640-940°K) at a constant condensation rate of the silicon monoxide. At a substrate temperature T_s = 640°K, the formation of films begins with the development of nuclei surrounding closely packed faces. At T_s = 720 and 940°K, the condensate forms a film with a clearly visible vicinal structure of closely packed {0111}, {0110}, {1120}, and {1122} faces. The measured desorption energies of crystalline SiO films (E_c = 3.1 ± 0.1 eV) and of thin SiO films (E_m = 4.1 ± 0.2 eV) which are strongly bound to the substrate surface, as well as the voltage–current characteristics of the Re–SiO system, indicate that both the growth of crystalline SiO films and the formation of nuclei occur in the transition layers of the absorbate. (auth)

15582 TUNGSTEN AND DISPERSION-STRENGTHENED TUNGSTEN MADE BY FREEZE DRYING. Ferrante, M. J.; Lowery, R. R.; Robidart, G. B. Rep. Invest. No. 7485. Washington, D. C.; Bureau of Mines (1971). 32p.

The applicability of the freeze-drying technique for preparing dispersion-strengthened W powders suitable for manufacturing of high-temperature-strength parts was investigated. Extruded rods from compacts of W–5 vol % thoria had at 1650°C a tensile strength of 30,300 lb/in^2 and a 10-h stress-rupture strength of 12,700 lb/in^2. These measurements are slightly below those for swaged rods of commercial W–3.7 vol % thoria. Only those W–thoria dispersions containing a stoichiometric deficiency of O yielded a significant strengthening effect. A low-melting eutectic formed in extruded W dispersions containing either zirconia or yttria, which caused a lowering of the tensile strengths. These tensile strengths were only slightly higher than strengths of elemental W made from commercial powder having a particle size of 2.4 μm. Sheet made from this commercial W had a slightly higher tensile strength than W made by freeze drying, but the freeze-dried W sheet had a lower recrystallization temperature, a lower ductile-to-brittle transition temperature and a higher purity. (Metals Abstr.)

15583 SINTERING BEHAVIOR OF URANIUM MONOPHOSPHIDE. Moench, Sigurd; Exner, Hans Eckart; Petzow, Guenter (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 62: No. 11, 830-5(Nov 1971). (In German).

By reaction of uranium and phosphorus, uranium monophosphide powder was produced which, after cold pressing, was sintered at temperatures between 1500 and 2000°C. The change of porosity, of specific interfaces, and of topological parameters of the pore space was measured as a function of sintering temperature and time. The specific surface of the pores reaches a maximum when the first pores start to close. The time dependence of density follows a parabolic function which is derivated from the observed changes in pore structure. Up to 1700°C evaporation and condensation contribute to material transport, between 1700 and 1950°C volume diffusion is the main process, and at higher temperatures fast shrinkage by liquid phase sintering occurs since free uranium forms due to selective evaporation of phosphorus. (auth)

15584 STABILITY OF CUBIC ZrO_2. Burchard, W. G.; Buresch, F. E. (Technische Hochschule, Aachen. Max-Planck-Institut fuer Metallforschung, Stuttgart). Ber. Deut. Keram. Ges.; 48: No. 11, 484-8(Nov 1971). (In German).

Coatings forming as a result of oxidation of Zr at 780°C in pure oxygen under a pressure of 0.1 torr consist of several modifications of zirconia. It was found by the electron back-reflection method that the outer layer adjacent to the oxygen atmosphere is a cubic modification. The inner layer of the coating was found, by x-ray diffraction to consist of monoclinic zirconia. On the basis of the experiments the thickness of the external cubic layer of the coating was estimated to be around 100 Å. This assessment is in agreement with thermodynamic calculations. Owing to a phase conversion in the adjacent monoclinic zirconia the external cubic layer is under a tensile stress which can be reduced by heating for 100 h at 780°C. (auth)

15585 URANIUM DIOXIDE. Ristic, Momcilo M. (ed.). Belgrade; Boris Kidric Institute of Nuclear Sciences (1971). 162p.

A selection of 16 papers previously published on the thermodynamics and sintering of UO_2, reactions in metal–UO_2 systems, and oxidation, microstructure, and tensile properties of UO_2 are included. (P.C.H.)

15586 RELATIONSHIP BETWEEN THE ACTIVATION ENERGY OF HIGH-TEMPERATURE CREEP AND THE DIFFUSION IN CARBIDES OF TRANSITION METALS. Zubarev, P. V.; Dementev, L. N. Probl. Prochnosti; No. 9, 47-51(Sep 1971). (In Russian).

The creep rates and values of the creep activation energy for $ZrC_{0.92}$ and $ZrC_{0.97}$ were determined for temperatures higher than 0.5 of the melting temperature. Based on the analysis of published creep and diffusion data in inclusion phases, it is demonstrated that the creep activation energy of metals of the fourth group of the periodic system and monocompounds of uranium, that is, of materials with a high binding energy Me–C, can be equal both to the diffusion activation energy of the metal and the carbon activation energy in carbides. In carbides of metals of the fifth group of the periodic system of stoichiometric composition, where the binding energy Me–Me increases, the creep

activation energy is equal to the diffusion activation energy of the metal in carbide. (JPRS)

15587 EFFECTS OF Mn, Si, Cr, AND Ni ON THE SOLUTION AND PRECIPITATION OF NIOBIUM CARBIDE IN IRON AUSTENITE. Koyama, Shinji; Ishii, Teruo; Narita, Kiichi (Kobe Steel Ltd., Japan). J. Jap. Inst. Metals; 35: No. 11, 1089-94(Nov 1971). (In Japanese).

The effects of manganese, silicon, chromium, and nickel on the solubility of niobium carbide in iron austenite have been studied on iron austenites containing various quantities of these elements with niobium by the method of equilibration with methane–hydrogen mixture gas. Manganese and chromium increased the solubility of NbC remarkably. Nickel increased the solubility NbC in comparatively low temperature range. But at higher temperature the effect was weak. On the contrary, silicon decreased the solubility of NbC. Such effects are attributed to the effect of each element on the activity of niobium as well as that of carbon. Solubility product of NbC in iron austenite containing manganese, silicon, chromium, or nickel was described by the following experimental equations, respectively: $\log[\%Nb][\%C] = -7970/T + 3.31 + (1371/T - 0.900)[\%Mn] - (75/T - 0.0504)[\%Mn]^2$, $\log[\%Nb][\%C] = -7970/T + 3.31 - (735/T - 0.348)[\%Si]$, $\log[\%Nb][\%C] = -7970/T + 3.31 + (1113/T - 0.691)[\%Cr] - (38/T - 0.0228)[\%Cr]^2$, and $\log[\%Nb][\%C] = -7970/T + 3.31 + (148/T - 0.0904)[\%Ni] + (8.5/T - 0.0068)[\%Ni]^2$. (auth)

15588 SVOISTVA SPLAVOV SISTEMY KARBID VOL'FRAMA–KOBAL'T. SPROVOCHNIK. (Properties of Alloys in the Tungsten Carbide–Cobalt System. Reference Manual). Tumanov, V. I. Moscow; Izdatel'stvo Metallurgiya (1971). 96p.

Data on the mechanical, physical, and chemical properties of alloys of the WC–Co system are tabulated and summarized. Quantitative information is provided on deformation by elongation, compression, and bending, Rockwell hardness, Vickers hardness, modulus of elasticity, and Poisson coefficients. Mechanical properties of the alloys during dynamic and cyclic testing are included. Successive sections are devoted to electrical properties, thermal expansion, heat conductivity, heat capacity and magnetic properties of the WC–Co alloys. (90 references) (K.S.W.)

15589 METHOD FOR PREPARING OXIDE GEL MICROSPHERES FROM SOLS. Haas, Paul A.; Clinton, Sam D. (to United States Atomic Energy Commission). U. S. Patent 3,617,585. 2 Nov 1971. Filed 23 Sep 1969.

A process for the production of gel microspheres characterized by a mean sphere diameter in the range of about 5 to 300 microns and a comparatively small proportion of spheres with diameters much smaller than the mean sphere diameter is described. A fine stream of a hydrous sol is introduced to a dehydrating stream of organic liquid through a capillary extending into the organic stream at an angle thereto. The flow rate of the organic stream is maintained at a value establishing a selected agitated flow condition at the capillary outlet, thereby producing a sol drop dispersion yielding gel microspheres of the character desired. (Official Gazette)

15590 PROCESS FOR MAKING PYROLYTIC CARBON COATED NUCLEAR FUEL OR POISON. Goedell, Walter V.; Luby, Charles S. (to Gulf Oil Corp.). U. S. Patent 3,619,241. 9 Nov 1971. Filed 9 Jun 1967.

A method of manufacturing a nuclear fuel or poison is described which includes heating particulate nuclear fuel or poison to between about 800 and 1400°C, contacting the heated material with an acetylene-containing atmosphere having an acetylene partial pressure of at least about 0.65 atmospheres to deposit a spongy pyrolytic-carbon coating on the particles followed by depositing a dense exterior fission products retentive coating on the spongy carbon coating. (Official Gazette)

15591 CORRELATION BETWEEN BORON/ALUMINUM SHEET QUALITY AND RESISTANCE WELD QUALITY AND STRENGTH. Hersh, M. S. (General Dynamics/Convair, San Diego, Calif.). Weld. J. (N. Y.); 50: No. 12, 515s-21s(Dec 1971).

Nondestructive test methods were employed to determine the quality of a boron/aluminum sheet including radiography, ultrasonic C-scanning, and micro-ohm resistance measurement. The last technique is described in detail. Among the three tests all types of quality defects were found and a topographical map was constructed detailing the local sheet quality. The quality was confirmed through examination of metallurgical cross-sections. Lap shear test specimens were made from the sheet by resistance spotwelding. Spotweld quality was determined by visual examination, radiography, and post-test metallurgical cross-sections. Strength was measured by lap shear tests. Various weld schedules were tried in an attempt to compensate for poor results in low-quality composite. The schedules included re-hitting spotwelds, reduced heat input, and use of aluminum foil in the faying surfaces. Results of this investigation clearly demonstrate that both spotweld strength and quality are directly affected by sheet quality, which allows qualitative characterization of "sound," "poor," and "bad" quality material. The use of sound material resulted in 100% sound welds with average lap shear strength (in longitudinal specimens) of 803 pounds; poor material resulted in 44% sound welds with average lap shear strength of 704 pounds; and bad material resulted in 23% sound welds and average lap shear strength of 497 pounds. (auth)

15592 FORMATION OF TERNARY PHASES OF Mo_5O_{14} AND $Mo_{17}O_{47}$ STRUCTURE IN THE MOLYBDENUM–WOLFRAM–OXYGEN SYSTEM. Ekstroem, Thommy (Univ. of Stockholm). Mater. Res. Bull.; 7: No. 1, 19-26(Jan 1972).

Two phases in the ternary Mo–W–O system, isostructural with the binary oxides Mo_5O_{14} and $Mo_{17}O_{47}$, have been identified by means of room-temperature x-ray powder photographs of samples prepared at 600 to 710°C. The widest ranges of formation of monophasic preparations have been observed for 600°C samples, viz. $0.05 \lesssim x \lesssim 0.30$ for $(Mo_{1-x}W_x)_5O_{14}$ and $0.10 \lesssim x \lesssim 0.30$ for $(Mo_{1-x}W_x)_{17}O_{47}$. The former oxide decomposes upon prolonged heating. The occurrence of phases with the Mo_5O_{14} and $Mo_{17}O_{47}$ structure type in several ternary systems and some conditions for their formation are discussed. (auth)

15593 THERMAL EXPANSION OF RUTHENIUM, OSMIUM, AND RHENIUM AT 77 TO 300°K: X-RAY DETERMINATION. Finkel, V. A.; Palatnik, M. I.; Kovtun, G. P. (Physical-Technical Inst., Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 212-16(Jul 1971). (In Russian).

The thermal expansion of Ru, Os, and Re was determined at 77 to 300°K by x-ray diffraction. There was a considerable anisotropy in each case, the longitudinal values being 5.1, 4.3, and 6.9 and the transverse values 7.4, 6.4, and 3.9, respectively, (all in $\times 10^{-6}$/°C). The volume expansion coefficients were 17.6, 15.0, and 17.6, respectively, (same units). These results are discussed in terms of the electron properties of the corresponding metals, and particularly the structure of the Fermi surface. (Metals Abstr.)

15594 PHASE EQUILIBRIA IN THE $FeO–Fe_2O_3–V_2O_3$ SYSTEM AT 1500°K. Wakihara, Masataka; Katsura, Takashi (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 44: No. 11, 3043-6(Nov 1971).

The phase equilibria in the $FeO–Fe_2O_3–V_2O_3$ system has been determined at 1500°K by varying the oxygen partial pressure. The following three oxide phases have been stable in equilibrium: a sesquioxide solid solution with a corundum-type structure (approximate composition $Fe_2O_3–V_2O_3$), a ternary solid solution with a spinel-type structure (approximate composition $FeO \cdot Fe_2O_3–FeO \cdot V_2O_3$), and a ternary wüstite solid solution with a periclase-type structure which dissolves vanadium ions up to about 10 mole percent. The extent of the solid-solution areas and the location of the oxygen isobars have been determined. The spinel phase coexisted partly with metallic iron and partly with the wüstite solid solution, corresponding to lower and higher iron contents respectively. The standard free energies of the $Fe + V_2O_3 + \frac{1}{2}O_2 = FeV_2O_4$ and $0.05\ Fe + V_2O_3 + Fe_{0.95}O = FeV_2O_4$ reactions to produce FeV_2O_4 have been calculated to be -45500 ± 200 cal and -5800 ± 400 cal, respectively at 1500°K on the basis of the equilibrium oxygen partial pressure. (auth)

15595 ION–MOLECULE EXPERIMENTS INVOLVING NEGATIVE IONS OF TUNGSTEN AND RHENIUM OXIDES. Center, R. E. (Avco Everett Research Lab., Everett, Mass.). J. Chem. Phys.; 56: No. 1, 371-6(1 Jan 1972).

Rate constants for the reactions of ReO_3^- and $(WO_3)_{n=1,2,3}^-$ with Cl_2 and NO_2 were measured in a drift-tube/mass spectrometer apparatus from thermal energies (295°K) to ~0.07 eV in the center of mass system. The rate constants for these reactions involving atom exchange agreed to within a factor of 2 with the theoretical orbiting rate constant of approximately 7×10^{-10} cm^3/sec for both reactants. ReO_4^- did not react with either NO_2 or Cl_2. Ordinary charge transfer was not observed, implying electron affinities in excess of 2.5 eV for these metal oxides. The mass-identified zero-field mobilities of these ions in Ar were measured at 295°K and were found to be 1.94, 1.67, 1.96, 1.50, and 1.20 cm^2 V^{-1} · sec^{-1} for ReO_3^-, ReO_4^-, WO_3^-, $(WO_3)_2^-$, and $(WO_3)_3^-$, respectively. (auth)

15596 DIMENSIONAL CHANGES IN GRAPHITES UNDER IRRADIATION. Virgil'ev, Yu. S.; Kalyagina, I. P. At. Energ. (USSR); 31: No. 5, 497-503(Nov 1971). (In Russian).

Dimensional changes in graphites resulting from neutron irradiation are in complex dependence on the accumulative dose,

temperature, and the structural and physical properties. Methods for quantitative determination of the dimensional behavior of graphites by means of models for monocomponent crystalline graphites, elastic deformation of graphite crystallites, relaxation of internal tensions localized in crystallites and formation and accumulation of vacant pores occurring at doses of about 2 to 3×10^{22} nvt were studied. The calculations showed satisfactory coincidence with the experimental results. (auth)

15597 STUDIES OF HYDROLYZABLE CARBIDES. VII. DECOMPOSITION OF SOME DICARBIDES OF THE TYPE $M^{III}C_2$ AND OF SCANDIUM CARBIDE WITH DEUTERIUM OXIDE. Hajek, B.; Brozek, V.; Popl, M.; Mostecky, J. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 36: No. 9, 3236-43 (Sep 1971).

Dicarbides of lanthanum, cerium, neodymium, samarium, gadolinium, terbium, holmium and yttrium and scandium carbide were prepared and decomposed using water or deuterium oxide. In both cases the same gaseous products were formed. The abundance of different hydrocarbon components and of hydrogen varied in dependence on the conditions of decomposition. However, the atomic ratio of hydrogen to carbon in the gaseous products remained the same, being ~1.5 with pure dicarbides. Yttrium, holmium, and scandium carbides showed a different character, indicated by the presence of methane and hydrocarbons with odd number of carbon atoms, especially of allylene, in the gaseous hydrolytic products. In the latter cases the H: C ratio was higher than 1.5. According to the purity of the deuterium oxide used, either totally or partially deuteriated hydrocarbons of the series $C_1 - C_{10}$ were formed, predominantly olefins and acetylenes. Their ir spectra display a distinct low-frequency shift. (auth)

15598 GROWTH OF CRYSTALS. VOLUME 7. Seventh International Crystallography Congress, Held in Moscow, July 20–21, 1966. Sheftal, N. N. (ed.). New York; Plenum Publishing Corporation (1969). 314p. $25.00. (CONF-660724-(Vol.7)).

Translated by J. E. S. Bradley.

Forty-nine papers on crystal morphology and single-crystal production were presented at the conference and are included in this volume. A separate abstract was prepared for the one paper in scope for NSA. (D.L.C.)

For abstract of individual paper see: 15599.

15599 CRYSTALLIZATION OF THE β-RHOMBOHEDRAL MODIFICATION OF BORON. Niemyski, T.; Pracka, I.; Jahn, J.; Badjan, A. (Physics Inst., Warsaw). pp 195-201 of Growth of Crystals. Vol. 7. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

The crystallization of the β form from the BCl_3-H_2 reaction product was studied, using zone melting by electron bombardment and Czochralski's method to grow the crystals. The direction in the (0001) plane was used to grow the polycrystals, and the temperature distribution along the crystal was measured. The crystals were examined in ir light, and effects of heating in H_2 were studied. (D.L.C.)

15600 GROWTH OF CRYSTALS. VOLUME 8. Seventh International Crystallography Congress, Held in Moscow, July 20–21, 1966. Sheftal, N. N. (ed.). New York; Plenum Publishing Corporation (1969). 315p. $25.00. (CONF-660724-(Vol.8)).

Translated by J. E. S. Bradley.

Fifty-two papers were presented at the conference impurity capture by growing crystals, epitaxy and production of single-crystal films, and theoretical aspects and are included in this volume. A separate abstract was prepared for each of five of the papers. The remaining papers were not within the scope of NSA. (D.L.C.)

For abstracts of individual papers see: 15601–15604 and 15728.

15601 SCANNING ELECTRON MICROSCOPY OBSERVATIONS OF THE INTERACTION BETWEEN ADSORBED IMPURITY ATOMS AND CRYSTAL GROWTH OF GRAPHITE. Minkoff, I. (Faculty of Mechanical Engineering, Haifa, Israel); Nixon, W. C. pp 24-33 of Growth of Crystals. Vol. 8. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

Observations were made with a scanning electron microscope of the interaction between impurity elements of the type that spheroidize graphite and graphite growth from the melt. The influence of the impurity element is to poison normal flake forms by adsorbing at the steps of screw dislocations. This leads to a progressive series of growth changes, the first of which is to form holes in the structure and promote branching of the crystal. Eventually, normal flake forms are completely eliminated and, as a final form, spherulitic crystals develop that may be considered as growth under conditions of melt impurity concentration, where complete coverage of the growing crystal is obtained. The undercooling at which growth takes place is that necessary to enable steps to traverse the crystal surface through the obtaining spacing of adsorbed impurity atoms. Observation of spherulitic graphite crystal surfaces shows that these are cellular in appearance, and growth hillocks are frequently capped by platelets. Factors that may influence growth on a spherical front are considered relative to growth processes incident on impurity adsorption. (auth)

15602 EFFECTS OF TEMPERATURE AND SUPERSATURATION ON THE ENTRY OF ALUMINUM INTO SYNTHETIC QUARTZ. Khadzhi, V. E.; Lelyakova, M. V. (All-Union Mineral Synthesis Research Inst., Aleksandrov, USSR). pp 43-6 of Growth of Crystals. Vol. 8. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

A study was made of the effects of crystallization temperature on the uptake of Al by quartz. The quartz crystals were grown by the gradient method, using hydrothermal quartz as the starting material, and observations were mainly on the rhombohedral growth pyramids. The Al distribution was determined by γ irradiation, annealing, and spectral analysis of the smoky color. (D.L.C.)

15603 ENTRY OF RARE-EARTH IMPURITIES INTO CeO_2 AND HfO_2 CRYSTALS GROWN FROM SOLUTION IN MELTS. Zonn, Z. N.; Ioffe, V. A. (Inst. of Silicate Chemistry, Leningrad). pp 63-4 of Growth of Crystals. Vol. 8. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

Single crystals of CeO_2 and HfO_2 were grown using a variety of melts. Gd, Tb, Er, Yb, and Dy were incorporated into CeO_2 by grinding and their ESR lines determined. Coprecipitation mixing enabled the HfO_2 to be doped with Gd^{3+}, Tb^{4+}, and Yb^{3+}; CeO_2 was also doped with Tb^{3+}, Tb^{4+}, Dy^{3+}, Yb^{3+}, and Nd in this way. (D.L.C.)

15604 CRYSTALLINE MODIFICATIONS OF BORON DEPOSITED ON BORON SUBSTRATES. Olempska, Z.; Badjan, A.; Pietrzak, K.; Niemyski, T. (Inst. of Physics, Warsaw). pp 157-60 of Growth of Crystals. Vol. 8. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

A study was made of deposition of boron from BCl_3-H_2 at 1600°C and the factors affecting the formation of the crystalline modification. The results show the appearance of tetragonal B, mixed with β-rhombohedral B, at deposition rates below ~14 mg/cm^2-h. The effect of air contamination on the tetragonal crystals was also studied. (D.L.C.)

15605 CORROSION RESISTANCE OF CHROMIUM AND TANTALUM DIBORIDES AND THEIR ALLOYS IN WATER AT HIGH TEMPERATURES AND PRESSURES. Arabei, B. G.; Myshkin, V. A.; Tikhonova, R. S.; Frolova, K. I. Zashch. Metal.; 7: No. 1, 16-19(Jan-Feb 1971). (In Russian).

The corrosion resistance of TaB_2, CrB_2, and TaB_2-CrB_2 alloys in water at high temperature and pressures (150 to 350°C and 5 to 170 atm) is discussed in the light of practical data, and a qualitative and quantitative estimation of the corrosion resistance is presented in terms of the constitution of the materials in question. An important factor to be borne in mind is the porosity of the samples, as porous materials have a large effective corrosion area. Thus CrB_2 was stable up to 300 and TaB_2 to 150°C. An alloy of TaB_2–40% CrB_2 was stable up to 250°C. (Metals Abstr.)

15606 GROUP ANALYSIS AND DECOMPOSITION OF THE CRYSTAL HAMILTONIAN IN FOURIER SERIES FOR HEXAGONAL BN. Smirnov, V. P.; Nakhmanson, M. S. Vestn. Leningrad. Univ., No. 10, Fiz., Khim.; No. 2, 39-45(May 1971). (In Russian).

The group analysis of crystal hexagonal BN was considered. The space group of hexagonal BN is D^1_{3h}. The representations of space group for symmetric points into Brillouin's zone and conditions of joint were found. The blocks of energy matrix for top valence bands (s, p_z and p_x, p_y bands) were constructed on the way of decomposition of the crystal Hamiltonian in Fourier series. (auth)

15607 NATURE OF THE FRACTURE OF CERMETS UNDER ABRASIVE EROSION. Kabral, Kh. I.; Mozberg, R. K. Tr. Tallin. Politekh. Inst., Ser. A; No. 294, 17-22(1970). (In Russian).

A fracture mechanism is described for the cermet alloys, TiC–Ni–Mo and WC–Co in conditions of abrasive erosion by quartz sand. The fracture of these fine-grain solid alloys was mainly controlled by the bond strength between the cementing and carbide constituents. The strength of the carbide phase increased with increasing carbide grain size. For mosaic structures the fracture was mainly determined by the grain strength of this structure. (Referativnyi Zh.)

15608 SINTERING OF BERYLLIA. IV. MECHANISM OF SINTERING DURING HOT PRESSING OF BERYLLIA. Moorthy, V. K.; Bhat, R. (Bhabha Atomic Research Center, Bombay). Trans. Indian Ceram. Soc.; 27: No. 5, 165-71(1968).

The beryllium oxide obtained by calcination of $Be(OH)_2$ at various temperatures was hot pressed at different temperatures and pressures. The densities obtained depended on the calcination temperature and increased directly with an increase in either the hot pressing temperature or pressure. The data is found to be in accord with McClelland's equation. Both the yield stress and activation energy are found to be enhanced with an increase in calcination temperature. (Indian Sci. Abstr.)

15609 PREPARATION OF METAL BORIDES. (to Reactor Centrum Nederland (Stitching). British Patent 1,257,544. 22 Dec 1971. Priority date 26 Mar 1968, Netherlands.

A method is described for the preparation of a metal boride, which comprises heating one or more halides or oxyhalides of one or more metals of the actinide or lanthanide or alkaline earth series of elements with B in the presence of one or more oxides of the corresponding metals(s), whereby a metal boride is produced. When halides or oxyhalides of the elements of the lanthanide or alkaline earth series are used, it is essential that the heating step take place in the presence of one or more oxides of the same element. The oxide is derived wholly or partly from a salt of the corresponding metal which is decomposed during the heating step to form the oxide. The metal borides produced are used as reactor control rods or as fissile material. (P.C.H.)

15610 ELASTIC MODULI AND THERMAL EXPANSION OF HIGH-POROSITY Mo–UO_2 CERMETS. Rowley, J. C.; Lawton, R. G.; Saunders, C. R. (Los Alamos Scientific Lab., N. Mex.). pp 12-17 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The optimum development of molybdenum-uranium dioxide cermet fuels for thermionic diodes requires an accurate determination of their mechanical and thermophysical properties. The temperature-dependence of the elastic moduli and the thermal expansion of Mo–UO_2 cermet samples at 0-, 10-, 20-, 50-, and 60-vol % contents have been determined. The cermets of interest are fabricated with significant porosity to provide for partial gaseous fission-product release and internal volumetric accommodation for the UO_2 swelling induced by the portion of gaseous fission products that is retained. The data indicate that, up to the ~15 vol % void level studied, the bulk thermal expansion of these cermet samples is not affected significantly by the pore content. A simple method-of-mixtures model suffices to describe the net expansion of these three-component particulate composites of molybdenum, UO_2, and void. In sharp contrast, the elastic-moduli data indicate that the void content significantly reduces the net rigidity of these cermets. Rectification of the moduli data to theoretically dense bodies indicates that the two phases, metal and ceramic, are not continuously bonded at their interfaces. Mechanical models which can describe the interactions of the cermet phases are being sought in an attempt to properly model the creep characteristics of such composites and to predict long-time fuel swelling behavior. (auth)

15611 FISSION-GAS SWELLING OF UC, UN, AND UO_2 AT HIGH IRRADIATION TEMPERATURES. Hilbert, R. F.; Storhok, V. W.; Chubb, W.; Keller, D. L. (Battelle Memorial Inst., Columbus, Ohio). pp 18-25 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Several samples of UC, UN, and UO_2, clad with 20-mil-thick W-26 Re, have been irradiated in the Battelle Research Reactor at temperatures ranging from 1500 to 1800°C to burnups of ~2.5 × 10^{20} fissions per cm^3. The initial swelling rate of nitrogen-rich UN was lowest of all the high-density fuels examined (about 3 vol % in 10^{20} fissions per cm^3 at 1600°C). UO_2 showed a slightly higher swelling rate (about 6 to 8 vol % in 10^{20} fissions per cm^3; cladding surface temperature of 1600°C). UC and nitrogen-deficient UN have still higher initial swelling rates (about 10 to 15 vol % in 10^{20} fissions per cm^3 at 1650°C). The introduction of as-fabricated porosity reduced the swelling rates of UN and UC but had no significant effect on the swelling rate of UO_2. (auth)

15612 DEVELOPMENTS IN PRESSURE-BONDED SHEATHED INSULATORS AND CERAMIC-TO-METAL SEALS. Weaver, C. V. (Los Alamos Scientific Lab., N. Mex.). pp 34-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Fabrication and machining techniques for the production of crack-free gas-pressure-bonded tri-layers are described. Tensile strengths of the ceramic-to-metal bonds exceed 5000 psi at 750°C, and the thermal conductivities of the tri-layers are approximately as calculated. Ceramic-to-metal seals may be machined directly from these tri-layers. The new process eliminates the necessity of a high-temperature braze, e.g., niobium-vanadium, in seal fabrication. Pressure-bonded seals have been cycled to 1750°C and heat-soaked without loss of vacuum integrity. Pressure-bonded pentalayers have also been produced. (auth)

15613 RADIATION-INDUCED DAMAGE TO CERAMICS IN THE EBR-II REACTOR. Reichelt, W. H.; Ranken, W. A.; Weaver, C. V.; (and others) (Los Alamos Scientific Lab., N. Mex.). pp 39-44 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Thin-walled cylinders of high-purity Al_2O_3 and Y_2O_3, mounted on isothermal irradiators, were exposed in the EBR-II reactor to maximum fast-neutron (E_n > 0.1 MeV) fluences of ~9.8 × 10^{21} nvt. All specimens changed color during irradiation. Alumina samples underwent maximum macroscopic volume changes of the order of 7%, but Y_2O_3 did not swell as a function of fluence. At fluences exceeding ~4 × 10^{21} nvt, most alumina specimens developed extensive grain-boundary separation and lost vacuum integrity. The electrical resistivity of the Al_2O_3 specimens decreased, but not enough to be significant in any practical application. Thermal diffusivities and conductivities decreased as a function of temperature and irradiation dose. X-ray analysis of Al_2O_3 lattice parameters showed a large degree of line broadening in the diffraction pattern, but no detectable change in the a and c lattice parameters. As found previously for samples irradiated in thermal reactors, damage effects were again closely related to grain size and impurity levels. (auth)

15614 EFFECT OF NEUTRON SPECTRA ON THE SWELLING OF ALUMINA UNDER IRRADIATION. Salmi, E. W.; Backus, C. E.; Frank, T. G.; Sutherland, C. D. (Los Alamos Scientific Lab., N. Mex.). pp 45-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Data on the swelling of alumina due to neutron irradiation is now available for several different neutron spectra. These data do not correlate well with the traditional fast-neutron fluence (E_n > 1 MeV). A neutron-energy-dependent model for predicting swelling of alumina is introduced which correlates the available data reasonably well and which consequently allows the prediction of the swelling of alumina in any neutron spectrum. It is also shown that the data is correlated fairly well by the neutron fluence where E_n > 0.15 MeV. (auth)

15615 RANDOM SUBSTITUTION OF Eu^{3+} FOR Y^{3+} IN Y_2O_3:Eu^{3+}. Forest, H.; Ban, G. (Zenith Radio Corp., Chicago). J. Electrochem. Soc.; 118: No. 12, 1999-2001(Dec 1971).

Results of an investigation to determine whether trivalent europium occupies the two inequivalent yttrium sites (C_2 and S_6) in Y_2O_3 (C-form) randomly or preferentially are presented. The distribution is found to be approximately random for concentrations greater than 1 atom percent by comparing the $^7F_0 \rightarrow {}^5D_1$ reflection spectra of Y_2O_3:Eu^{3+} and C-form Eu_2O_3 powders. From the uncertainty of the measurements, an estimate is made for the ordering energy (~250 cm^{-1}) which is the maximum difference in the energy of Eu^{3+} located at the two sites. (auth)

15616 PARTIAL PRESSURES IN THE Cd–Te AND Zn–Te SYSTEMS. Brebrick, R. F. (Massachusetts Inst. of Tech.,

Lexington). J. Electrochem. Soc.; 118: No. 12, 2014-20(Dec 1971).

Partial pressures of Te_2, Cd, and Zn have been determined to within 10% for a number of compositions in the Cd–Te and Zn–Te systems by measuring the optical density of the vapor phase between 1990 and 7000 Å. For Te-saturated CdTe(c), the partial pressure of Te_2, p_2, reaches a maximum value of 0.188 atm near 915°C. For Cd-saturated CdTe(c), p_{Cd} is within a few per cent of that for pure Cd up to 840°C. At the 1092°C melting point, p_2 = 5.5 (10^{-3}) and p_{Cd} = 0.65 atm. At 900°C the homogeneity range for CdTe(c) is shown to lie within outer limits of 49.0 and 50.5 at. % Te and ΔG_f varies by less than 150 cal/g-atom between either Cd-saturated or Te-saturated and congruently subliming CdTe(c). Liquidus temperatures and the partial gram-atomic enthalpy and entropy are obtained for 55.0, 60.0, and 65.0 at.% Te melts. The liquidus points confirm the presence of an inflection point in the Te-rich liquidus and it is shown that this behavior is due primarily to the nonideal behavior of the Cd activity coefficient. Similarly, p_{Zn} for Zn-saturated ZnTe(c) has been determined to 900°C and p_2 for the Te-saturated ZnTe(c) to 1080°C. The homogeneity range at 900°C is bracketed between outer limits of 49.5 and 50.5 at. % Te corresponding to a maximum variation of ΔG_f of 190 cal/g-atom between either Zn-saturated or Te-saturated and congruently subliming ZnTe(c). (auth)

15617 APPLICATION OF ION EXCHANGE TO THE FABRICATION OF NUCLEAR FUEL. Luina, Adolfo Perez (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 15: No. 72, 283-8(Jul-Aug 1971). (In Spanish).

The fuel characteristics of reactors presently in operation and soon to be in operation are introduced. A new process for the fabrication of microspheres of fuel, with a base principally of heavy metal oxides, is described. The experimental studies of the steps of the process are outlined. The steps considered are charge of the ion exchange resins, calcination or carbonization of the charged resin microspheres, and coating with pyrolytic carbon. (tr-auth)

15618 PRODUCTION OF RAW MATERIALS FOR THE MANUFACTURE OF ELECTROMELTED REFRACTORIES. Mirkin, L. V. (Moscow Inst. of Steel and Alloys); Lainer, A. I.; Kolenkova, M. A.; (and others). Ogneupory; No. 7, 12-15(Jul 1971). (In Russian).

A baddeleyite-corundum refractory material is manufactured from a mixture of ZrO_2, zircon, and alumina. It is proposed to duplicate this product without the use of ZrO_2 by adjusting the aluminum fluoride/zircon mixture to the optimal value in the reaction: $3(ZrO_2 \cdot SiO_2) + 4AlF_3 \rightarrow 3ZrO_2 + 2Al_2O_3 + 3SiF_4$. The results are given for a number of experimental charges in a rotating furnace, the roasting product attaining a temperature of 1130 to 1180°C. The resulting granulated sintered material was judged suitable for preparing the desired refractory. (K.S.W.)

15619 ELECTRODE POTENTIAL FALLS AND RESISTANCE OF ZIRCONIUM OXIDE-BASE ELECTRODES IN A FLOW OF IONIZED GAS. Zelikson, Yu. M.; Ivanov, A. B.; Kirillov, V. V.; Reshetov, E. P.; Flid, B. D. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 425-9 (May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 462-7(May-Jun 1971).

An apparatus simulating the operating conditions of an open-cycle magnetohydrodynamic generator was used in order to study zirconium oxide electrodes stabilized with yttrium oxide, having metal leads in the form of wires or a disc collector. The operation of these was studied by visual observations in the channel, and the state of the working zone was analyzed after the tests. Using a tangential probe, the resistance of the electrodes was measured under working conditions; it depended very largely on the construction of the leads. The resistance of the electrode fell with increasing current density. The cathode drop was measured for electrodes with a working surface of stabilized zirconium dioxide in the electrode temperature range 1450 to 1700°C at current densities of up to 3 A/cm², and an approximate $U_K = f(j_1, T_{el})$ relationship was derived. (auth)

15620 POROUS PARTICLE FABRICATION PROCESS. David, Constant V. U. S. Patent 3,619,428. 9 Nov 1971. Filed 5 Apr 1968.

A method is described for fabrication of spheroids of porous carbon incorporating dispersed metal or metallic compounds powders. The particles have controlled size, shape, and porosity. The metallic compound may comprise fissionable material precured in resin particles. The cured particles can be pyrolyzed producing the spherical shape and effecting a char matrix binding the compounds together. (J.R.D.)

15621 INVESTIGATIONS OF EUROPIUM OXIDE CERMETS WITH A VIEW TO THEIR USE FOR CONTROL RODS IN NUCLEAR REACTORS. Hoffmann, A.; Pant, P. (Krupp Friedr. GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 29: No. 2, 15-25 (1971). (In German).

Results of investigations of the preparation of europium mixed oxides with MoO_3 and TiO_2 and of sintered specimens of europium mixed oxides and V2A- or V4A-powders, respectively, are reported along with those from investigations of the microstructures and of the corrosion resistance of these cermets in water. The manufacture of plated cermet kernels with europium oxide contents between 40.75 and 51.0% is described. The perfect structure of the prepared cermet plates could be demonstrated by means of metallographic and x-ray investigations. (INIS)

15622 PROCESS FOR COATING ARTICLES WITH PYROLYTIC CARBON. (to Gulf Oil Corp.). British Patent 1,258,275. 30 Dec 1971. Priority date 18 Jan 1968, United States.

A process is described for coating particles with two layers of pyrolytic carbon. The process provides for deposition of one dense coating and one relatively less dense coating. Provisions are also included for control of anisotropy in the coatings. The process is used in coating fuel particles and neutron poison materials. (J.R.D.)

15623 PROCESS FOR COATING PARTICLES AND PRODUCTS RESULTING THEREFROM. (to Gulf Oil Corp.). British Patent 1,256,101. 8 Dec 1971. Priority date 28 Mar 1968, United States.

A method of depositing four concentric coatings on fuel particles is described. The inner layer is low-density pyrolytic carbon at least 20-μ thick. The second layer is impermeable pyrolytic carbon thick enough to provide a gas barrier. The third layer is densé silicon carbide or zirconium carbide and the exterior layer is dense isotropic carbon. These particles may be used in high-temperature high-radiation environments. (J.R.D.)

15624 HIGH-TEMPERATURE ENTHALPY AND SPECIFIC HEAT OF ERBIUM SESQUIOXIDE. Tsagareishvili, D. Sh.; Gvelesiani, G. G. (Inst. of Metallurgy, Tbilisi, USSR). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 588-9(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 643-4(May-Jun 1971).

The enthalpy of Er_2O_3 was measured over the range 298 to 1600°K by the method of mixtures. The following equations were derived for 298.15 to 1675°K: $H_T - H_{298.15} = 30.93\ T + 0.39 \times 10^{-3}\ T^2 + 4.65 \times 10^5\ T^{-1} - 10817$ cal/mole and $C_P = 30.93 + 0.78 \times 10^{-3}\ T - 4.65 \times 10^5\ T^{-2}$ cal/mole · degree. The discrepancies of the calculated values from those of Pankratz and King's equations are tabulated for various points over the 400 to 1600°K range. (D.L.C.)

15625 PROCESS FOR COATING CARBON AND GRAPHITE ARTICLES. (to Sigri Elektrographit Gesellschaft Mit Beschraenkter Haftung). British Patent 1,258,372. 30 Dec 1971. Priority date 21 Jan 1969, Germany.

A method is described for coating carbon or graphite articles with Si, B, a transition metal or combinations of these elements. The surface to be coated is heated to 700 to 1400°C in vacuum or inert atmosphere and contacted with a powdered mixture of the coating elements and selected carbides, oxides, or nitrides in the presence of halides. (J.R.D.)

15626 PREPARATION AND SOME PROPERTIES OF BERKELIUM METAL AND CALIFORNIUM DIOXIDE. Fahey, James Andrew. Knoxville, Tenn.; Univ. of Tennessee (1971). 130p. University Microfilms Order No. 71-29,459.

Thesis.

The first bulk (5 μg) samples of berkelium metal were prepared by the reduction at ~1025°C of BkF_3 with lithium metal in a tantalum crucible system. The BkF_3 starting material was obtained by air ignition of individual resin beads to BkO_2 followed by treatment with a $H_{2(g)}$-$HF_{(g)}$ mixture at 600°C. All but one of the samples prepared to date exhibited a face centered cubic (fcc) phase with a lattice parameter of 4.997 ± 0.004 Å. In addition, several samples exhibited a double hexagonal close packed (dhcp) phase with lattice parameters of a_0 = 3.416 ± 0.03 Å and c_0 = 11.069 ± 0.007 Å. Present data indicate that the fcc phase is the high-temperature phase with respect to the dhcp phase. Magnetic susceptibility studies show that the dhcp phase has more +4 character than the fcc phase, in agreement with calculated metallic radii of 1.70_4 Å (dhcp) and 1.76_7 Å (fcc). During the course of this work and in some similar work with Am, Cm, and Cf it was found that, under conditions suitable for the preparation of microgram quantities of these metals, the relative volatilities are given by Cm ≪ Bk < Am ≪ Cf. The melting point of Bk metal was determined to be 986 ± 25°C (90% confidence). The preparation of CfO_2 is re-

ported. Air ignited individual resin beads were converted to a diphasic product by exposure to molecular oxygen at 100 atm, 300°C for 100 hours. The major phase (face centered cubic phase) is believed to be CfO_2. Evidence is presented indicating that the second phase was a substoichiometric "dioxide." The dioxide was black and exhibited a face centered cubic lattice parameter of 5.312 ± 0.005 Å. The lattice parameter for the dioxide falls on the smooth curve of the other actinide dioxide lattice parameters plotted against atomic number and extrapolated to californium. The stoichiometry of the sample was not directly determined but rather assumed to be approximately that of the dioxide on the basis of x-ray crystallographic results, by analogy to similar lanthanide and actinide oxide systems and considerations of the preparative chemistry employed. (Diss. Abstr. Int., B)

15627 DEFORMATION CONDITIONS AND FRACTURE EFFECTS IN SINTERED WC–Co. Frank, Jaromir. Pokroky Praskove Met. VUPM; No. 4, 3-35(1970). (In Czech).

A critical account based on the literature dealing with the problem of deformation conditions and fracture effects in sintered WC–Co is presented. The characteristics of individual phases, values of solubility of WC in Co are given in detail; the sintering process, also the boundaries WC/WC, WC/Co, and Co/Co, are described. The mechanical and physical properties of sintered WC–Co are dealt with, including a summary of up-to-date published information on deformation conditions. More research is recommended on the stress and deformation between two adjoining grains of WC and Co, the strength of the WC/Co interphase boundaries, the strength of WC/WC grain boundaries, and the influence of defects in Co binding phase caused by the C defect in the WC. (Metals Abstr.)

15628 STUDY OF THE PRODUCTION OF COMPLEX TITANIUM–TUNGSTEN CARBIDES. Erinin, Khristo; Stoyanov, Lyudmil. Rudodobiv Met. (Sofia); 25: No. 10, 55-8(Oct 1970). (In Bulgarian).

Methods of producing complex TiC–WC alloys are described and discussed, with special reference to the relative proportions of free and combined C in alloys of various compositions, and the effects of such C on the structure and mechanical properties of the material as a whole. Thus the amount of combined C tends to increase with increasing proportion of WC in the alloy. On adding 0.5% of Co to an original mixture with a substoichiometric C content, a complex carbide in which nearly 20% of the C is combined with the Ti results. (Metals Abstr.)

15629 STRUCTURE OF GLASSES OF THE COMPOSITION $6MeO \cdot Nd_2O_3 \cdot 7SiO_2$ (Me = Ca, Sr, Ba). Shevyakov, A. M.; Andreev, I. F.; Tunik, T. A.; Tarlakov, Yu. P.; Fedorov, N. F. (Leningrad Polytechnic Inst.). Dokl. Akad. Nauk SSSR; 200: No. 2, 355-7(11 Sep 1971). (In Russian).

The following properties were determined for glasses having the composition $6\ MeO \cdot Nd_2O_3 \cdot 7\ SiO_2$, where Me represents Ca, Sr, or Ba: melting point, refractive index, density, molar volume, microhardness, and absorption spectra. The presence of polymerized SiO_2 tetrahedra and their dimensions in the structure of these glasses are discussed. (K.S.W.)

15630 PHASE STUDIES OF THE SYSTEMS Nd_2O_3–SiO_2–MeO (Me = Ca, Sr, Ba). Shevyakov, A. M.; Andreev, I. F.; Tunik, T. A.; Kasparyan, R. M.; Tarlakov, Yu. P. (Leningrad Technological Inst.). Dokl. Akad. Nauk SSSR; 199: No. 2, 331-3(11 Jul 1971). (In Russian).

Phase studies were made in the pseudobinary systems Nd_2SiO_5–$MeSiO_3$ where Me represents Ca, Sr, or Ba. The concentration limits were determined for those areas of homogeneity characterized by the apatite structure and possessing the general formula $MeNd_4(SiO_4)_3O$. Phase analyses were conducted with infrared spectroscopy in the range 1,600 to 400 cm^{-1}. A linear relationship for the three points: Ca, Sr, and Ba was observed when the fundamental absorption frequencies were plotted against $R\sqrt{M}$, in which R in the ionic radius and M is the atomic weight of the element (K.S.W.)

Metals and Alloys

15631 (CONF-680614) TECHNICAL PAPERS OF THE TWENTY-SECOND METALLOGRAPHIC GROUP MEETING HELD JUNE 19–21, 1968, GULF GENERAL ATOMIC, INC., SAN DIEGO, CALIFORNIA. Roman, Harriet Roth (comp.) (General Electric Co., Lynn, Mass.). Dec 1971. 368p. Dep. NTIS.

Twenty-eight articles are included; separate abstracts were prepared for 25. The remaining three articles on electromechanical polishing of some refractory carbides containing graphite, metallographic preparation and microscopic examination of a Mo–UO_2 cermet fuel, and cathodic vacuum etching with H were previously abstracted in NSA as 22: 36525, 36526, and 49753. (P.C.H.)

For abstracts of individual papers see: 15118, 15164, 15165, 15348, 15563–15567, 15633, 15663–15671, 15754–15757, 15841, and 15849.

15632 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. November 1971. Band 5, Heft 11. 221 Referate (Register-Nr. 4158-4592), 87 Referate (Register-Nr. 543 T-629 T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. November 1971. Vol. 5, No. 11. 221 Abstracts (Register No. 4158-4592), 87 Abstracts (Register No. 543 T-629 T)). Karlsruhe, Ger.; Gesellschaft Fuer Kernforschung m.b.H (1971). 156p. (In German and English).

Corrosion and Erosion

Refer also to abstracts 14703, 15113, 16892, and 16984.

15633 (CONF-680614–, pp 64-70) TECHNIQUES FOR IDENTIFICATION OF MICROQUANTITIES OF CORROSION PRODUCTS ON MINIATURIZED ELECTRONIC COMPONENTS. Braun, J. D. (Mound Lab., Miamisburg, Ohio). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A method is discussed for removing and identifying microquantities of corrosion products on miniature high purity Cu electrodes molded in asbestos-filled diallyl phthalate between which a precious metal bridge-wire was soldered with a soft solder of composition (wt %) 37.5 Pb–37.5 Sn–25 In. This technique involves extraction replication and use of electron microscopy, electron diffraction, and microprobe analyses. The corrosion product was found to consist of both Pb_3O_4 and Cu_2S. The presence of the Cu_2S led to a detailed study of the entire production process and the eventual solution of a serious production corrosion problem. (auth)

15634 (EUR-4691) BEHAVIOUR OF STEELS IN ATMOSPHERES CONTAINING CO AND H_2 AND THE EFFECT OF PRETREATMENT AND GASEOUS ADDITIVES. Karcher, W.; Glaude, P. (European Atomic Energy Community, Petten (Netherlands), Joint Nuclear Research Center). Aug 1971. 26p. Dep. NTIS (U. S. Sales Only). EUR FF 4.45.

The behavior of various heat exchanger steel materials in gas mixtures containing 0.1 to 1 vol % CO and H_2 and approximately 10 vpM of H_2O has been investigated in the temperature range of 400 to 600°C for periods of exposure up to 2,000 hours under flow conditions. It was found that in these conditions mild steels, steels with low Cr-content and ferritic steels tend to form carbon deposits whereas austenitic steels and Ni-based alloys undergo superficial oxidation, the latter causing considerable weight increases in the case of alloys with very high Ni-content. For the low alloyed steels, the effect of pretreatment with phosphoric acid, SO_2, and silanes and the influence of the addition of CO_2, NH_3, N_2O, H_2O, silanes, and SO_2 to the flowing gas mixture has been studied as well. The results of these experiments suggest a considerable reduction of carbon deposition both by the pretreatment and the injection technique. In both cases, the best results have been obtained with SO_2 which suppressed carbon deposition completely even if a weighty deposit had been formed previously. Good results have been observed also with silanes and with a phosphoric acid pretreatment. In the case of CO_2, NH_3, N_2O and H_2O addition relatively high concentrations are required to prevent deposition of carbon, the inhibiting effect increasing in the order CO_2 to H_2O. It is believed that the inhibition effect of phosphoric acid, silanes, and SO_2 is due to the formation of a protective surface layer whereas the retarding influence of CO_2, NH_3, N_2O, and H_2O is attributed to the competitive chemisorption of NH_3 and H_2O with CO and H_2 at the carbon deposition reaction sites. (auth)

15635 EFFECT OF OXYGEN PRESSURE ON THE INITIAL STAGE IN THE OXIDATION OF MOLYBDENUM. Kolot, V. Ya.; Tatus, V. I.; Rybalko, V. F.; (and others) (Physical-Technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 6, 1275-7(Dec 1971).

Translated from Fiz. Tverd. Tela; 13: No. 6, 1521-4(Jun 1971).

The effect of oxygen pressure in the range 5×10^{-8} to 1×10^{-4} torr on the initial stage of the oxidation of molybdenum has been studied by the secondary ion–ion emission method. Increasing the oxygen pressure leads to: (1) a reduction in the latent period (the time interval between the beginning of oxygen adsorption and the moment at which oxides form on the molybdenum surface); (2) a reduction in the time required for an equilibrium

oxide film to form on the surface; and (3) an increase in the oxide concentration. The state of the surface film (composition and concentration of oxides) is reproducible and reversible with change in temperature and oxygen pressure, indicating that the oxide film consists of a layer of surface oxides. (auth)

15636 STUDY OF THE INTERACTION KINETICS BETWEEN OXYGEN AND TANTALUM USING THE FLASH METHOD. Ageev, V. N.; Ionov, N. I. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 6, 1305-10(Dec 1971).

Translated from Fiz. Tverd. Tela; 13: No. 6, 1557-63(Jun 1971).

Using the flash method in conjunction with a pulse time-of-flight mass spectrometer, the interaction kinetics taking place between oxygen and tantalum were studied for oxygen pressures of $\sim 10^{-7}$ mm Hg in the temperature range 300-2400°K. The only observed desorption product was the oxide TaO_2 desorbed in the form of a single phase. The apparent oxygen adhesion coefficient S was independent of the degree of surface coverage θ for $\theta < 1$ and $\theta > 1.5$ at absorbent temperatures of $T < 1100$°K, and for all values of θ at $T > 1100$°K. The adhesion coefficient was independent of temperature for $\theta < 1$ and $T < 1100$°K, but increased sharply with increasing temperature for $T > 1100$°K. A model is developed for calculating the dependence of the adhesion coefficient on θ, on the assumption that the adsorbed molecules are characterized by certain preliminary states. A procedure for calculating the amount of oxygen absorbed by tantalum is proposed on the assumption that the rate of oxygen absorption by tantalum is determined by processes taking place at the metal–gas interface. (auth)

15637 INVESTIGATION OF THE OXYGEN–TUNGSTEN INTERACTION BY ION DESORPTION PRODUCED BY SLOW ELECTRONS. Ageev, V. N.; Kutsenko, E. N. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 5, 841-2(Nov 1971).

Translated from Zh. Tekh. Fiz.; 41: No. 5, 1065-7(May 1971).

Results of examination of the O^+ current produced by slow electrons from oxygen adsorbed on W at absorbent temperatures of 300 to 1700°K at constant O_2 pressure are presented. The uptake of O_2 occurs through accumulation of oxides, indicating a layered structure for the oxide film. (J.R.D.)

15638 CORROSION OF THORIUM AND THORIUM ALLOYS AND REACTIONS WITH THE ENVIRONMENT. Blumenthal, B.; O'Boyle, D. R. (Argonne National Lab., Ill.). Nucl. Eng. Des.; 17: No. 3, 281-96(1971).

The published literature on reactions between metallic thorium and oxygen, nitrogen, air, hydrogen, and water vapor is briefly reviewed. For reactions with oxygen and nitrogen the reaction rate follows a parabolic-rate law at low temperatures, but is linear at higher temperatures. The change in reaction kinetics is apparently due to the process being diffusion controlled in the temperature range where the reaction layer is continuous but controlled by the reaction at the surface-layer base-metal interface at higher temperatures. The reaction rate between thorium and air was found to be linear from 100 to 900°C, while the reaction rate between thorium and hydrogen was parabolic up to 700°C. Observed reactions between thorium and its alloys and water vapor, acids, molten metals, organic coolants, and fluorine compounds are briefly reviewed. In addition several topics of interest to fuel-element designers such as the corrosion of defected fuel elements, and the compatibility of thorium alloys with cladding materials are summarized. (55 references) (auth)

15639 SOME CONSIDERATIONS ON THE IMPROVEMENT OF THE CORROSION PROPERTIES OF ZIRCONIUM AND ZIRCONIUM ALLOYS. Hauffe, K. (Univ., Goettingen, Ger.). Werkst. Korros.; 22: No. 7, 604-12(1971). (In German).

Problems arising in connection with an improvement of the corrosion resistance of zirconium alloys are discussed. In order to understand and clarify the corrosion mechanism in the scale layer, essential consequences of false arrangements in zirconium dioxide were studied. This is followed by an account of studies on the mechanism of the oxidation process, and based on these findings, a variety of methods is discussed which might lead to an improvement of the nonscaling property and corrosion resistance. Suggestions as to a new research program to be initiated for the study of nonscaling zirconium alloys are also mentioned. (INIS)

15640 CORROSION OF METALS IN DISTILLED WATER AT 250°C. Byalobzheskii, A. V.; Anurova, G. M. Zashch. Metal.; 7: No. 2, 112-17(Mar-Apr 1971). (In Russian).

The corrosion of Fe, Ni, Cr, Ta, Mo, Cu, and various alloys in distilled water under pressure in an autoclave at 250°C was studied by chromatographic, gravimetric, and x-ray methods. All the metals tested underwent a certain amount of corrosion under these conditions. Hydrogen being evolved in each case, although the part played by the evolving H in the corrosion mechanism was only a minor one. The main corrosion process was the formation of an oxide or hydroxide film, which was then decomposed by the electrolyte. Formulas representing the progress of the corrosion processes are derived. (Metals Abstr.)

15641 KINETICS OF THE OXIDATION OF NIOBIUM–ZIRCONIUM ALLOYS IN CARBON DIOXIDE. Konev, V. N.; Levina, R. A. Zashch. Metal.; 7: No. 4, 401-4(Jul-Aug 1971). (In Russian).

The kinetic characteristics of the oxidation of Nb–Zr alloys in CO_2 at high temperature (up to 1000°C) were studied gravimetrically and the results were correlated with x-ray structural analysis. Phase analysis of the scale so formed agreed with the theoretical Wagner (J. Electrochem. Soc., 1952, 99, 369) model regarding the oxidation of binary alloys in which the compounds formed mutually-insoluble oxides. The scale so formed had certain protective properties in relation to alloys in the middle of the range of compositions. (Metals Abstr.)

15642 COMPARATIVE CORROSION TESTS ON ZINC AND CADMIUM COATINGS. Kudryavtseva, I. D.; Lipkina, L. A.; Skalozubov, M. F.; Yurinskaya, L. V. Zashch. Metal.; 7: No. 1, 63-6(Jan-Feb 1971). (In Russian).

Corrosion tests in a humidity cabinet on Zn, Cd, and Zn/Cd coatings deposited from electrolytes of various compositions are described. In general the Cd coatings withstood the tests better than the Zn; combined Zn/Cd coatings had a lower corrosion resistance than single layers. Zn coatings obtained from NH_3 electrolytes had a greater corrosion resistance than those obtained from CN^- electrolytes. Bright coatings had a greater corrosion resistance than matt coatings. The thickness of the coating had comparatively little effect on corrosion. (Metals Abstr.)

15643 OXIDATION OF MAGNESIUM AND POWDER METALLURGICAL MAGNESIUM–BERYLLIUM ALLOYS IN CARBON DIOXIDE AT A PRESSURE OF 60 ATMOSPHERES. Zelenskii, V. F.; Petel'guzov, I. A.; Sulimov, N. A. Zashch. Metal.; 7: No. 2, 132-6(Mar-Apr 1971). (In Russian).

The oxidation of Mg and Mg–Be alloys in CO_2 gas with various degrees of humidity was studied at 470 to 580°C under a pressure of 60 atm. In CO_2 containing more than 1% of water vapor both the metal and the alloys decomposed as a result of intercrystallite and intracrystallite oxidation, and also suffered an increase in dimensions resulting from the penetration of H into the metallic matrix. By mounting the Mg or Mg–Be alloys on substrates of other metals, which strongly absorb gaseous H, the high-temperature oxidation of the Mg and Mg–Be was markedly reduced. (Metals Abstr.)

15644 CORROSION RESISTANCE OF TITANIUM–VANADIUM–OXYGEN AND TITANIUM–VANADIUM–ALUMINUM–OXYGEN ALLOYS. Gurevich, S. M. Zashch. Metal.; 7: No. 2, 159-60(Mar-Apr 1971). (In Russian).

The corrosion resistance of Ti–V and Ti–V–Al alloys containing traces (up to 0.5 wt. %) of O in various acids (HCl, H_2SO_4, acetic, and formic) was studied. After treatment in HCl and H_2SO_4, in particular, these alloys suffered a certain amount of corrosion but retained their metallic lustre; the lowest corrosion rate was obtained for alloys containing 0.3% O. Testing in acetic and formic acid yielded characteristic colored oxide films on the surface but no harmful corrosion. (Metals Abstr.)

15645 ZIRCALOY-2 CORROSION IN STEAM–WATER MIXTURE UNDER REACTOR RADIATIONS. Cerrai, E.; Gadda, F.; Scaroni, A. (CISE, Milan). Energ. Nucl. (Milan); 18: No. 11, 607-14(Nov 1971).

Corrosion rates of Zircaloy-2 in steam–water mixture were studied in out-of-pile and in-pile conditions. Two closed-cycle loops were used for these tests. Most of the experiments were carried out in neutral condition, that is without any addition of chemicals to the feed water; only some preliminary tests were performed in an ammoniated environment. The experiments were carried out on corrosion coupons in as-pickled conditions; the exposure time for in-reactor tests was of the order of 70 days. The results obtained on both oxidation rate and hydrogen pickup are reported for the different experimental conditions investigated. (auth)

15646 ANODIC DISSOLUTION OF CORROSION-RESISTANT STEELS IN SILICOHYDROFLUORIC ACID. Bozin, N. A.;

Gulyaev, V. E. Zashch. Metal.; 7: No. 2, 164-6(Mar-Apr 1971). (In Russian).

The effects of H_2SiF_6 on the anodic dissolution of a number of corrosion-resistant steels and Cr–Ni, Cr–Ni–Mo, and Cr–Mo alloys were studied. The anodic activation and passivation processes taking place in this acid were extremely sensitive to the composition of the alloys in question as well as the acid concentration. Thus one particular Cr–Mo alloy (Cr–2% Mo) had a high-stability passive state and resisted activation by SiF_6^{2-} ions over a wide range of potentials, in complete contrast to the behavior of Cr–Ni steels. (Metals Abstr.)

15647 COMPOSITION OF THE FILMS FORMED ON METALS IN DISTILLED WATER AT 250°C. Byalobzheskii, A. V.; Plavnik, G. M.; Anurova, G. M.; Fedorova, G. M. Zashch. Metal.; 7: No. 2, 177-8(Mar-Apr 1971). (In Russian).

The compositions of the films on the surfaces of Cu, Cd, W, Mo, Nb, Zr, Ti, Ni, and Fe after contact with distilled water under pressure at 250°C were studied by x-ray phase analysis. Not all the films were thick enough to be identified; however, in those that were, the composition was equally divided between oxides and hydroxides. For example, Cd developed films of $Cd(OH)_2$ with local regions of CdO, while Fe developed films of α-$FeHO_2$ with traces of γ-$Fe_2O_3 \cdot H_2O$. The W and Mo samples formed the corresponding trioxides. (Metals Abstr.)

15648 EFFECT OF OXIDIZING AGENTS ON THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF NICKEL–MOLYBDENUM ALLOY EP 496 IN HYDROCHLORIC ACID. Kashcheeva, T. P.; Dubikhina, V. S.; Gadasina, L. Yu.; Meshcheryakova, I. D.; Rutkovskii, M. L. Zashch. Metal.; 7: No. 1, 11-15(Jan-Feb 1971). (In Russian).

The effects of oxidizing agents (elemental O and Fe^{3+}) on the corrosion and electrochemical behavior of the Ni–Mo alloy EP 406 in 22% HCl were studied at 20 to 100°C. The rate of corrosion of this alloy was largely determined by the concentration of the depolarizer and the rate of access of the depolarizer to the corroding surface. When using this alloy for constructional purposes it is therefore vital to ensure the absence of oxidizing agents. On working in concentrated HCl at high temperature the absence of Fe in particular is essential. (Metals Abstr.)

15649 EFFECT OF NITRIDING ON THE CORROSION RESISTANCE OF NIOBIUM AND TANTALUM. Kiparisov, S. S.; Levinskii, Yu. V.; Strogonov, Yu. D.; Kryuchkova, N. A. Zashch. Metal.; 7: No. 4, 464-5(Jul-Aug 1971). (In Russian).

The effects of nitriding on the corrosion resistance of Nb and Ta in mineral acids were studied. In HCl, HNO_3, mixtures of these, and also in H_2SO_4 at low temperature and concentrations, the nitriding metals had the same corrosion characteristics as the unnitrided. In 87% H_3PO_4 at 205°C or H_2SO_4 (95%) at 290°C, however, nitriding produced a 100-fold increase in corrosion resistance. In alkalies also, nitriding increased the corrosion resistance of the metals by 10 to 30 times. It also sharply raised the surface hardness and wear resistance of these metals. (Metals Abstr.)

15650 KINETICS OF EQUILIBRIUM AND HEAT TRANSFER IN THE HYDROGENATION OF U. Caralp-Amilhat, F.; Destriau, M. (Univ., Bordeaux). Bull. Soc. Chim. Fr.; No. 10, 3425-32(Oct 1971). (In French).

Two mechanisms, one of the nucleation type, and the other of the diffusion type, are involved when U is reacted with hydrogen. Their respective contributions vary with the reaction temperature and the bulk or divided state of the metal. If particulate metal is used, the heat evolved during the reaction produces an increased temperature in the medium. By correcting the kinetic curves obtained, it was possible to determine the real temperature at the maximum reaction rate. This is different in the two cases since the kinetic processes are different. The value of the real temperature at maximum rate and the analysis of the kinetic curves demonstrate that the equilibrium perturbs the kinetics in a range remote from equilibrium conditions. (France)

15651 VANADIUM ALLOY DEVELOPMENT FOR SODIUM-COOLED REACTORS. Klueh, R. L.; DeVan, J. H. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Des.; 17: No. 3, 371-6(1971).

Because of favorable nuclear properties and high-temperature mechanical properties, vanadium alloys are attractive as possible fuel cladding materials for sodium-cooled fast-breeder reactors, the only disadvantage being vanadium's affinity for oxygen that leads to the formation of non-adherent oxides when vanadium or vanadium alloys are exposed to sodium containing more than several parts per million of oxygen. Over the years numerous binary and several ternary alloys have been tested, and all have exhibited the above described behavior. It is now generally accepted that sodium contacting vanadium alloy fuel cladding must be trapped to avoid scale formation. Hence, it is possible to use vanadium alloy cladding if it can be protected from serious damage during any oxygen excursion. The oxidation problem and several possibilities for protecting the cladding during an oxygen excursion are discussed. (auth)

15652 SOME CONSIDERATIONS CONCERNING THE IMPROVEMENT OF THE SCALING RESISTANCE OF ZIRCONIUM AND ZIRCONIUM ALLOYS. Hauffe, K. Werkst. Korros.; 22: 604-12(1971).

Improving the scaling resistance of Zr and its alloys requires a reduction of gas solubility in the metal and an improvement of scale adhesion to the base metal. For this reason only such alloy additions are eligible which are either incorporated in the scale layer or form a ductile or molten alloy phase between the base metal and the ZrO_2 layer being formed. In this way one would on the one side prevent the scale layer from becoming porous (thus also eliminating the possibility of hydrogen diffusion into the base metal) while on the other hand the scale layer would be prevented from spalling off under shearing stress. These possibilities are discussed in terms of probable mechanisms for the action of alloying additions such as Sn and Al. (Corrosion Abstr.)

15653 COMPATIBILITY OF $^{244}Cm_2O_3$ WITH REFRACTORY METALS AT THERMIONIC TEMPERATURES. DiStefano, J. R. (Oak Ridge National Lab., Tenn.). pp 26-33 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The power density of $^{244}Cm_2O_3$ makes it an attractive candidate as a fuel form for radioisotopic thermionics. Experiments were conducted over the past several years to evaluate the compatibility of $^{244}Cm_2O_3$ with various refractory metals and alloys. Tests with Ta, Ta–10% W, T-111, Mo, TZM, W, and W–26% Re were conducted for 1,000 and 10,000 h at 1650°C and 1,000, 5,000, and 10,000 h at 1850°C. At 1650°C extensive reactions of $^{244}Cm_2O_3$ with tantalum and the tantalum alloys were found. Complete penetration of Ta–10% W and up to 0.030-in. grain boundary penetration of T-111 occurred after 10,000 h. Only limited attack occurred in Mo, TZM, W, and W–26% Re, mainly in the form of subsurface voids and/or bubbles. Although the melting temperature of pure $^{244}Cm_2O_3$ is approximately 2100°C, it had melted in all of the tests with tantalum or tantalum alloys at 1850°C. After 5,000 and 10,000 h, mass transfer of tantalum was found from specimen to capsule wall and relatively pure tantalum particles were identified in the fuel, indicating that dissolution of tantalum had occurred. However, the type of attack that occurred at 1650°C was not observed. Evidence of dissolution and fuel melting was also found with the other materials at 1850°C, but the data were not as conclusive as with the tantalum materials. Large tungsten particles were found in the fuel in tests with pure tungsten and lesser amounts in tests with W–26% Re. It was concluded that W–26% Re, TZM, and Mo showed the best compatibility with $^{244}Cm_2O_3$ at 1850°C and all would appear to be satisfactory container materials. (auth)

15654 HIGH-POWER ELECTRICAL BREAKDOWN TESTS OF CRACKED-INSULATOR COLLECTOR SHEATHS WITH FLOWING LIQUID METAL COOLANT. Kikin, G. M. (Jet Propulsion Lab., Pasadena, Calif.); Danko, J. C. Contract NAS7-100. pp 49-57 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Breakdown-voltage and high-power tests have been run on several pressure bonded collector sheath tubes with cracked alumina insulators. Ceramvar–alumina and niobium–alumina sheaths were tested in flowing liquid-metal at coolant temperatures of 550 to 750°C and at cesium reservoir temperatures of 150 to 400°C to determine whether catastrophic mechanical damage would occur if high power arc currents were to flow through cesium-vapor filled cracks of a cracked insulator sheath. Puncture of the sheath collector by high arc current would cause loss of liquid metal coolant and subsequent failure of the thermionic reactor. True simulation of expected thermionic reactor thermal operating conditions was provided by using flowing liquid metal coolant (NaK), at nominal design velocity and temperature, to cool the collector sheath. The test results of these experiments are presented and discussed with respect to their impact on design of thermionic reactors. (auth)

15655 EFFECT OF CHROMIUM AND MOLYBDENUM ON THE ELECTROCHEMICAL AND CORROSION BEHAVIOR OF NICKEL–CHROMIUM–MOLYBDENUM ALLOYS. Andrushova, N. V.; Kazakova, G. V.; Svistunova, T. V.; Chermenskaya, N. F. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 77, 141-5 (1970). (In Russian).

The effects of the Cr and Mo contents in Ni–Cr–Mo alloys on their corrosion and electrochemical behavior were determined in 30% H_2SO_4 at 90°C and in 10% HCl at 20°C. Alloying of a Ni–15% Mo alloy with Cr up to 25% significantly increased its corrosion resistance over the whole of the potential range studied. Mo, when present in amounts >10%, improved the corrosion resistance of Ni–10% Cr alloys in reducing media but had the opposite effect in oxidizing media. (Referativnyi Zh.)

15656 INTERCRYSTALLINE CORROSION OF ALLOYS CONTAINING CHROMIUM 20 PERCENT AND NICKEL 40 PERCENT IN RELATION TO THE ALLOYING. Zakharov, Yu. V.; Levin, F. L.; Sentyurev, V. P.; Grishin, A. M.; Markeshin, V. S. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 77, 95-8 (1970). (In Russian).

Long-term tests, up to 5000 hr, were used to determine the effects of C, Nb, Mn, Si, Cr, N, and Al on the resistance of Fe–20% Cr–40% Ni alloys to intercrystalline corrosion in the temperature range 500 to 900°C. Alloying with Mn and Al markedly reduced the resistance of these alloys to this form of attack after sensitization by heat treatment. Raising the austenization temperature to 1200°C lowered the resistance. (Referativnyi Zh.)

15657 EFFECTS OF COLD WORK ON THE OXIDATION OF ZIRCONIUM AT 425 TO 550°C. Lee, Key S.; Lee, Byoung W.; Park, Pyung C. J. Korean Inst. Metals; 8: No. 4, 191-7(Mar 1971).

The effect of cold work on the oxidation rate of Zr in O from 425 to 550°C was investigated. The oxidation rate decreased with increasing amounts of cold work (0 to 30% by compression) and activation energies of 36.6 and 45.7 kcal/mole were calculated for the temperature ranges 425 to 490°C and 490 to 550°C, respectively. The oxidation followed a cubic rate law. (Metals Abstr.)

15658 OXIDATION OF THE [ALUMINUM] ALLOY AL8 CONTAINING SOLID-STATE [HIGH-MELTING-POINT] ELEMENTS. Nikitina, M. F.; Tikhonov, A. A. Izv. Vyssh. Ucheb. Zaved., Mashinostr.; No. 1, 151-4(1971). (In Russian).

The effects of additions of Be, B, Mo, and Zr on the oxidation of the AL8 [Mg 9.5 to 11.5, Ti 0.07, Be 0.07] were studied. The oxidation rate was reduced by small additions of Be and B but was increased by Mo and practically unaffected by Zr. The oxide films that were formed had a complex structure. (Referativnyi Zh.)

15659 REALIZATION OF A STEP FUNCTION OF PRESSURE WITH THE HELP OF A MOLECULAR BEAM: CATALYTIC ETHYLENE OXIDATION ON TUNGSTEN. Lintz, Hans-Guenther; Pentenero, Andre; Le Goff, Pierre (CNRS, Villers, France). Ber. Bunsenges. Phys. Chem.; 75: No. 10, 1042-5(Oct 1971). (In German).

One of the advantages of the molecular beam technique is that it enables the sudden variation of the number of gas molecules incident on a surface, this corresponding to a step-function of its pressure. This experimental possibility is demonstrated by the example of catalytic ethylene oxidation on tungsten, because the reaction rate is strongly influenced by the ratio of the partial pressures of the two gases. Introducing a step-function pressure change alters this ratio suddenly after which the evolution of the catalytic surface from one stationary state to another can be observed. Results show that, in principle, it is possible to measure the reaction probabilities of elementary reactions as a function of both surface temperature and surface state (e.g., the partial coverage by an adsorbed gas) and further to follow the passivation of this surface by one of the reactants. (auth)

15660 MATERIALS FOR WEAR-RESISTANT SURFACES. Foster, J. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Des.; 17: No. 2, 205-46(1971).

The basic nature of the wearing process is reviewed in terms of macroscopic phenomena and related briefly to microscopic considerations such as crystal structure and hardness. Problems confronting the designer are examined, and alternatives dependent upon design conditions are discussed. Major emphasis is on four groups of metals and alloys and on cermets, ceramics, graphite, and plastics. Applications are related to the desirable properties of each of these materials. Composition, property, and application data are presented in tables and figures. Reference sources were intentionally drawn largely from journal literature and reports on recently developed property and application data current at the time this material was written. A brief list of supplemental references is included relating largely to wear problems in aerospace and nuclear environments. (auth)

15661 CORROSION PHENOMENA: TESTING METHODS AND REMEDIAL MEASURES. Meckelburg, E. Draht; 21: No. 5, 328-38(May 1970). (In German).

The different forms of corrosion are discussed together with the corrosion testing procedures and appropriate protective measures. The choice of corrosion-resisting materials is dealt with and the effects of aeration of the corrosive media are discussed. Protective metallic zinc, cadmium, and lead coatings are considered and the use of zinc and lead in cathodic protection systems is briefly described. (Corrosion Abstr.)

Preparation and Fabrication

Refer also to abstracts 15123, 15164, 15612, 15625, 15626, and 17133.

15662 (CEA-R-4204) PREPARATION AND THE PROPERTIES OF PLUTONIUM POWDER. Fontaine, Claude (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Nov 1971. 71p. (In French). Dep. NTIS (U. S. Sales Only).

Plutonium was prepared as a fine powder (<200 μm) by the thermal decomposition of its hydride under a constant hydrogen pressure. Investigations of the chemical properties of this powder indicate that its ignition temperature in air is less than 200°C, and that the contamination occurring during its manufacture is negligible. The sintering behavior can be deduced from the physical properties of the powder, e.g., particle size, grain shape, density, and compactibility. The apparent density of the pellets was between 8 and 11 g/cm^3. (France)

15663 (CONF-680614–, pp 1-9) METALLOGRAPHIC PREPARATION OF PLUTONIUM. Rafalski, A. L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Procedures are given for electropolishing and electroetching pure plutonium and delta phase stabilized plutonium alloys. The electrolytes used in this investigation were based on orthophosphoric acid. Photomicrographs are included which are representative of results obtainable using the techniques described. (auth)

15664 (CONF-680614–, pp 10-18) ELECTROLYTIC POLISHING AND ETCHING OF ALPHA PLUTONIUM. Rencken, D. G. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Alpha plutonium microstructures that reveal sharply delineated grain boundaries have been produced with an electrolytic polisher-etcher. A microscope was used for observing the surface during polishing and etching. Specimens could be satisfactorily electrolytically polished at 3.0 A/cm^2 for 10 to 30 sec in a solution of 10% nitric acid, 20% ethylene glycol, and 70% methanol, and electrolytically etched at 30 mA/cm^2 for 1.5 to 3 min. This technique also provides a very rapid means for polishing and etching alpha plutonium directly from the as-machined condition. The microstructures reveal more detail than is generally shown by either grain-relief etches or etches for polarized light illumination. The microstructures are comparable to those that can be obtained by ion bombardment, but electrolytic polishing and electrolytic etching provide more consistent results and are much simpler. (auth)

15665 (CONF-680614–, pp 143-52) METALLOGRAPHIC TECHNIQUES FOR VACUUM-CAST ROLLED INGOT BERYLLIUM SHEET. Calabra, Arthur E.; Jackson, Ross J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Two techniques developed for the metallographic preparation of vacuum-cast ingot beryllium sheet are described. Both methods yield metallographically prepared surfaces considered to be of the highest quality. The first method retains inclusions and requires polarized illumination for structural delineation. The second method is an electrolytic swab-etch technique which yields bright-field delineation of the microstructure; however, inclusions are not retained. Emphasis is mainly on illustrating the effects that improper preparation can have on the resulting microstructure. (auth)

15666 (CONF-680614–, pp 269-81) TECHNIQUES FOR THE PREPARATION OF TRANSMISSION ELECTRON MICROSCOPY SPECIMENS FROM TUBING. DuBose, C. K. H.; Jones, C. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The application of transmission electron microscopy to engineering materials requires techniques for preparing specimens from intricate structures. Suitable flat tabs can be cut or ground from massive pieces and thinned using standard techniques, but small-diameter, thin-wall tubing presents special problems that cannot be handled in this way. Modifications to the ORNL jet polishing technique that enable good specimens to be rapidly and reliably prepared from tubing using a minimum of material are described. Special features of a glove-box facility for thinning alpha-contaminated materials are also described. (auth)

15667 (CONF-680614–, pp 282-8) PREPARING ZIRCONIUM ALLOYS FOR TRANSMISSION ELECTRON MICROSCOPY. Owens, C. M.; Davies, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A technique for preparing zirconium alloys for transmission electron microscopy is described. Foils of high quality were obtained consistently from relatively small test sections. Typical micrographs are given of results obtained on Zircaloy-4 (pre- and post-irradiated) and several of the common alloys of zirconium. (auth)

15668 (CONF-680614–, pp 289-96) ELECTRON MICROSCOPE-MICROPROBE ANALYSIS OF PRECIPITATION. Gehlbach, R. E. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Understanding the role of microstructure on mechanical and physical properties of alloy systems necessitates the identification of precipitated phases occurring in these materials. An electron probe microanalyzer accessory to the electron microscope, used in conjunction with standard electron microscope specimens, provides the means for obtaining a quick and reliable analysis of individual precipitates. The uniqueness of this tool is most apparent when using extraction replicas, permitting chemical analysis without matrix interference along with usual electron microscopy and diffraction of individual particles in the same spatial distribution as the bulk material, of the thin dendritic morphology often present in grain boundaries, of a size or distribution too fine to be resolved by conventional microprobe techniques, and in quantities not detectable by x-ray diffraction analysis of extraction residues. (T.F.D.)

15669 (CONF-680614–, pp 297-313) TRANSMISSION ELECTRON MICROSCOPY INVESTIGATION OF HAYNES ALLOY NO. 25 AND ELECTRON BEAM WELDS IN THIS ALLOY. Downs, Gene L. (Mound Lab., Miamisburg, Ohio). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A method for preparing thin specimens of Haynes alloy No. 25 for transmission studies is discussed. The technique retains most of the usual inclusions in the alloy. The substructure of the alloy is given and discussed. (auth)

15670 (CONF-680614–, pp 314-21) PREPARATION OF BERYLLIUM FOILS FOR TRANSMISSION ELECTRON MICROSCOPY. Grotzky, V. K.; Fraikor, F. J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Transmission electron microscopy investigations of the effects of various heat treatments on lattice defects in beryllium ingot sheet require thin foils which are representative of the bulk material. However, beryllium ingot sheet which has been annealed at elevated temperatures is particularly susceptible to damage by preparation techniques such as diamond saw cutting, spark cutting, etc. A chemical saw has been devised and constructed to provide strain-free cutting of coupons from the bulk ingot sheet. The saw consists essentially of an acid-soaked thread which moves across the specimen through the action of an eccentrically mounted pulley. Thin slices of 0.030 in. to 0.050 in. thick can easily be obtained from the heat-treated beryllium sheet. These specimens are chemically thinned to approximately 0.015 in. thick and subsequently electrolytically thinned by a dual-jet technique. Several representative photomicrographs are given of precipitate and dislocation structures in beryllium foils obtained from tested tensile specimens, electron beam welds, and quenched and aged ingot sheet. (auth)

15671 (CONF-680614–, pp 322-35) REPLICATION OF IRRADIATED MATERIALS FOR ELECTRON MICROSCOPY. Miller, John L. Jr. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Various replicating techniques have been used to examine highly-radioactive materials by electron microscopy. Heretofore, obtaining replicas of good quality and acceptable activity levels have required either costly sophisticated equipment or tedious time-consuming techniques. A description is given of a good, two-stage technique for obtaining high-quality replicas. Examples of electron micrographs from polished, etched, and fractured materials are presented with comments on the merits of carbon and metallic replicas. (auth)

15672 (KFK–1418) SPECIAL RESEARCH METHODS IN THE FIELD OF REACTOR MATERIAL. Short Collection of Seminar Proceedings, Winter 1970/71. Frieser, H. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Jun 1971. 30p. (In several languages). Dep. NTIS (U. S. Sales Only).

Eight seminar papers on research methods are compiled. They include analysis of plutonium-containing and irradiated fuels, investigation methods in the hot cells of reactor plants, investigations on the accuracy of electron beam microanalysis, quantitative microscopic texture analysis, nucleation phenomena in gas–metal reactions, investigation methods for plutonium-containing fuels, review of analysis methods used in chemical analytical laboratories with emphasis on modern methods, and particle size measurement by electron microscopy in the size range 500 Å to 2μ. (J.S.R.)

15673 (ORNL-TM–3550) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1971. Patriarca, P. (Oak Ridge National Lab., Tenn.). Dec 1971. Contract W-7405-eng-26. 249p. Dep. NTIS.

Research and development progress is reported on FBR oxide fuels, advanced fast breeder reactor fuels, FBR neutron absorber materials, FBR fuel cladding materials, compatibility of LMFBR boiler materials, joining and nondestructive testing of materials, mechanical properties of structural materials, UN fuels for space power, tungsten metallurgy, metallurgy of refractory alloys, and cladding materials for space isotopic heat sources. (J.R.D.)

15674 (RDT-M–1-3-T(7-71)) MILD STEEL COVERED WELDING ELECTRODES (ASME SFA-5.1 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 7p. RSO.

A standard prescribing requirements for mild steel covered welding electrodes (ASME SFA-5.1 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-3T dated February 1969. (J.R.D.)

15675 (RDT-M–1-5-T(7-71)) WELDING RODS AND ELECTRODES, SURFACING (AWS A5.13 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 5p. RSO.

A standard prescribing requirements for welding rods and electrodes, surfacing (AWS A5.13 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 1-5T, dated April 1968. (J.R.D.)

15676 (RDT-M–1-7-T(7-71)) COPPER AND COPPER ALLOY WELDING ELECTRODES (ASME SFA-5.6 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 7p. RSO.

A standard prescribing requirements for Cu and Cu alloy welding electrodes (ASME SFA-5.6 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 1-7T dated February 1969. (J.R.D.)

15677 (RDT-M–1-8-T(7-71)) COPPER AND COPPER ALLOY WELDING RODS (ASME SFA-5.7 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 5p. RSO.

A standard prescribing requirements for Cu and Cu alloy welding rods (ASME SFA-5.7 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-8T dated February 1969. (J.R.D.)

15678 (RDT-M–1-9-T(7-71)) BRAZING FILLER METAL (ASME SFA-5.8 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 4p. RSO.

A standard prescribing requirements for brazing filler metal (ASME SFA-5.8 with additional requirements) for nuclear and as-

sociated applications is presented. This standard supersedes RDT M 1-9T, dated February 1969. (J.R.D.)

15679 (RDT-M-1-10-T(7-71)) NICKEL AND NICKEL ALLOY COVERED WELDING ELECTRODES (ASME SFA-5.11 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 6p. RSO.

A standard prescribing requirements for Ni and Ni alloy covered welding electrodes (ASME SFA-5.11 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-10T, dated February 1969. (J.R.D.)

15680 (RDT-M-1-11-T(7-71)) NICKEL AND NICKEL-ALLOY BARE WELDING RODS AND ELECTRODES. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 6p. RSO.

A standard prescribing requirements for nickel and nickel alloy bare welding rods and electrodes for nuclear and associated applications is presented. This standard supersedes RDT M1-11T, dated February 1969. (J.R.D.)

15681 (RDT-M-1-15-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY BARE WELDING RODS AND ELECTRODES (ASME SFA-5.14 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 7p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy bare welding rods and electrodes (ASME SFA-5.14 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15682 (RDT-M-1-16-T(1-72)) ZIRCONIUM AND ZIRCONIUM ALLOY BARE WELDING RODS (ASTM B351 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 5p. RSO.

A standard prescribing requirements for Zr and Zr alloy bare welding rods (ASTM B351 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M1-16T dated May 1970. (J.R.D.)

15683 (RDT-M-1-17-T(7-71)) MILD STEEL ELECTRODES FOR SUBMERGED ARC WELDING (ASME SFA-5.17 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 7p. RSO.

A standard prescribing requirements for mild steel electrodes for submerged arc welding (ASME-5.17 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15684 (RDT-M-1-19-T(1-72)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM BARE WELDING RODS AND ELECTRODES (ASME SFA-5.14 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 7p. RSO.

A standard prescribing requirements for Ni–Cr–Mo–Nb bare welding rods and electrodes (ASME SFA-5.14 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15685 (RDT-M-2-1-T(7-71)) CARBON STEEL FORGINGS (ASME SA-105 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 9p. RSO.

A standard prescribing requirements for carbon steel forgings (ASME SA-105 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-1T dated February 1969. (J.R.D.)

15686 (RDT-M-2-2-T(1-72)) STAINLESS AND LOW ALLOY STEEL FORGINGS (ASME SA-182 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 10p. RSO.

A standard prescribing requirements for stainless steel and low alloy steel forgings (ASME SA-182 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-2T dated July 1971. (J.R.D.)

15687 (RDT-M-2-4-T(7-71)) ALLOY STEEL FORGINGS (ASME SA-336 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 10p. RSO.

A standard prescribing requirements for alloy steel forgings (ASME SA-336 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-4T dated February 1969. (R.C.K.)

15688 (RDT-M-2-7-T(7-71)) CARBON AND ALLOY STEEL FORGINGS, VACUUM TREATED (ASME SA-508 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 7p. RSO.

A standard prescribing requirements for carbon and alloy steel forgings, vacuum treated (ASME SA-508 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-7T dated February 1969. (J.R.D.)

15689 (RDT-M-2-8-T(7-71)) ALLOY STEEL FORGINGS (ASME SA-541 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 8p. RSO.

A standard prescribing requirements for alloy steel forgings (ASME SA-541 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-8T dated November 1967. (J.R.D.)

15690 (RDT-M-2-11-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY FORGINGS (ASME SA-182 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 9p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy forgings (ASME SA-182 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15691 (RDT-M-2-12-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY WELDING FITTINGS (ASME SA-403 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 9p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy welding fittings (ASME SA-403 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15692 (RDT-M-2-15-T(7-71)) NICKEL–CHROMIUM ALLOY BARS, FORGINGS, AND FORGING STOCK (ASTM A637 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 9p. RSO.

A standard prescribing requirements for Ni–Cr alloy bars, forgings, and forging stock (ASTM A637 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15693 (RDT-M-3-1-T(7-71)) CARBON STEEL SEAMLESS PIPE (ASME SA-106 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 8p. RSO.

A standard prescribing requirements for carbon steel seamless pipe (ASME SA-106 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-1T dated February 1969. (J.R.D.)

15694 (RDT-M-3-2-T(12-71)) STAINLESS AND ALLOY STEEL SEAMLESS TUBES (ASME SA-213 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Dec 1971. 11p. RSO.

A standard prescribing requirements for stainless steel and alloy steel seamless tubes (ASME SA-213 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-2T dated July 1971. (J.R.D.)

15695 (RDT-M-3-3-T(1-72)) AUSTENITIC STAINLESS STEEL SEAMLESS PIPE (ASME SA-376 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 10p. RSO.

A standard prescribing requirements for austenitic stainless steel pipe (ASME SA-376 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-3T dated July 1971. (J.R.D.)

15696 (RDT-M-3-4-T(7-71)) NICKEL ALLOY SEAMLESS TUBES (ASME SB-163 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 9p. RSO.

A standard prescribing requirement for nickel alloy seamless tubes (ASME SB-163 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-4T dated February 1969. (J.R.D.)

15697 (RDT-M-3-8-T(1-72)) ZIRCONIUM AND ZIRCONIUM ALLOY TUBES (ASTM B353 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 6p. RSO.

A standard prescribing requirement for Zr and Zr alloy tubes

(ASTM B 353 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-8T dated February 1969. (J.R.D.)

15698 (RDT-M-3-9-T(1-72)) NICKEL–IRON–CHROMIUM ALLOY SEAMLESS PIPE AND TUBING (ASME SB-407 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 9p. RSO.

A standard prescribing requirements for Ni–Fe–Cr alloy seamless pipe and tubing (ASME SB-407 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-9T dated July 1971. (J.R.D.)

15699 (RDT-M-3-10-T(7-71)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY SEAMLESS PIPE AND TUBES (ASME SB-167 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 12p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy seamless pipe and tubes (ASME SB-167 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15700 (RDT-M-3-11-T(7-71)) CARBON AND LOW ALLOY STEEL WELDED PIPE (ASME SA-155 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 9p. RSO.

A standard prescribing requirements for carbon and low alloy steel welded pipe (ASME SA-155 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15701 (RDT-M-3-12-T(7-71)) FERRITIC ALLOY STEEL SEAMLESS PIPE (ASME SA-335 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1971. 9p. RSO.

A standard prescribing requirements for ferritic alloy steel seamless pipe (ASME SA-335 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 3-12T dated February 1969. (J.R.D.)

15702 (RDT-M-3-18-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY SEAMLESS TUBES (ASME SB-163 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 11p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy seamless tubes (ASME SB-163 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15703 (RDT-M-3-29-T(1-72)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY SEAMLESS TUBES (AMS 5589 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 8p. RSO.

A standard prescribing requirements for Ni–Cr–Mo–Nb alloy seamless tubes (AMS 5589 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15704 (RDT-M-3-30-T(1-72)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY SEAMLESS TUBES (AMS 5590 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 8p. RSO.

A standard prescribing requirements for Ni–Cr–Mo–Nb alloy seamless tubes (AMS 5590 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15705 (RDT-M-4-5-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY CASTINGS (ASTM A494 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 9p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy castings (ASTM A 494 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15706 (RDT-M-5-1-T(1-72)) STAINLESS STEEL PLATE, SHEET, AND STRIP (ASME SA-240 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 10p. RSO.

A standard prescribing requirements for stainless steel sheet, plate, and strip (ASME SA-240 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 5-1T dated July 1971. (J.R.D.)

15707 (RDT-M-5-7-T(1-72)) NICKEL–IRON–CHROMIUM ALLOY PLATE, SHEET, AND STRIP (ASME SB-409 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 6p. RSO.

A standard prescribing requirements for Ni–Fe–Cr alloy plate, sheet, and strip (ASME SB-409 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 5-7T dated July 1971. (J.R.D.)

15708 (RDT-M-5-8-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY SHEET AND PLATE (ASME SB-434 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 8p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy sheet and plate (ASME SB-434 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15709 (RDT-M-5-20-T(1-72)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY PLATE, SHEET, AND STRIP (AMS 5597 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 7p. RSO.

A standard prescribing requirements for Ni–Cr–Mo–Nb alloy plate, sheet, and strip (AMS 5597 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15710 (RDT-M-5-21-T(1-72)) NICKEL–CHROMIUM–MOLYBDENUM–COLUMBIUM ALLOY PLATE, SHEET, AND STRIP (AMS 5596 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 7p. RSO.

A standard prescribing requirements for Ni–Cr–Mo–Nb alloy plate, sheet, and strip (AMS 5596 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15711 (RDT-M-7-6-T(1-72)) PRECIPITATION-HARDENING STAINLESS STEEL BARS, SHAPES, AND FORGINGS (ASTM A564 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 12p. RSO.

A standard prescribing requirements for precipitation-hardening stainless steel bars, shapes, and forgings (ASTM A564 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDTM 7-6T dated July 1971. (J.R.D.)

15712 (RDT-M-7-11-T(1-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY ROD AND BAR (ASME SB-336 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1972. 8p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy rod and bar (ASME SB-336 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

15713 (UCRL-51109) USE OF SHOCK WAVES IN THE VAPORIZATION OF METALS. Ahrens, Thomas J.; Urtiew, Paul A. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Aug 1971. Contract W-7405-eng-48. 47p. Dep. NTIS.

Explosively induced shock waves in aluminum, iron, stronium, lithium, thorium, uranium, and barium are capable of vaporizing appreciable quantities of these metals. When plane shock waves are incident upon porous samples, they will induce vaporization in aluminum, iron, strontium, thorium, and barium. Although Mach stem shocks act on a smaller selective mass of material, they will induce sufficient entropy to vaporize uranium and lithium. When a Mie–Grüneisen equation of state is assumed, it is found that for a given plane explosive system an initial porosity exists that will optimize the shock-induced entropy production in a metal. The optimum initial distention that will result in maximum post-shock entropy is found to vary between 1.6 and 2.0 times the volume of the crystal for several of the metals examined. (auth)

15714 SPUTTERED Au–Ta–O CERMET FOR THIN FILM RESISTORS: A PRELIMINARY STUDY. Harvey, J.; Corkhill, J. (Royal Aircraft Establishment, Farnborough, Eng.). Thin Solid Films; 8: No. 6, 427-45(Dec 1971).

Au–Ta–O films have been made by reactive sputtering, with sheet resistivities of up to 4 kΩ/□, temperature coefficients of resistance of less than ~300 ppM/°C and stability of <10% change after 1000 hr at 125°C. Further work to improve stability would be necessary to take practical advantage of the high sheet resistivity available. (auth)

15715 EFFECT OF PROCESS PARAMETERS ON RESISTANCE WELDING OF TUBES–PLUGS OF REACTOR FUEL RODS. Albano, F. (Politecnico, Turin). Riv. Ital. Saldatura; 23: No. 3, 145-51(1971). (In Italian).

The results of an investigation, conducted at FIAT–SEN on the possibility of sealing the ends of reactor fuel rods by re-

sistance welding, are presented. Welding tests were performed after experimental measurements of the contact resistance. On the basis of these results, it was possible to set out a theoretical calculation, allowing the determining of the influence of the physical and electrical parameters on the temperature distribution and the quantity of molten metal. The possibility of using values of the process parameters near those obtained by the theoretical calculations was checked for welding. It was also noted that for correct welding a perfect alignment of the pieces to be joined is necessary. (INIS)

15716 SATURATION OF IRON WITH TUNGSTEN UNDER THE INFLUENCE OF A LASER LIGHT BEAM. Mirkin, L. I. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 2, 98-101(1971). (In Russian).

The possibility of creating Fe–W alloys by subjecting an Fe base coated with W to the action of an intense laser beam, or by directing a similar beam at a mixture of Fe and W powders, is asserted on the basis of small-scale tests. A solid solution of the Fe–W type containing some 20 at. % W may thus be achieved; this value considerably exceeds the limiting solubility under equilibrium conditions. An analysis of the x-ray line widths obtained from such samples shows that the structure is far from equilibrium and contains an anomalously large number of defects. (Metals Abstr.)

15717 MECHANIZED WELDING OF NICKEL AND ITS ALLOYS. Strassburg, Friedrich Werner. Schweissen Schneiden; 23: No. 6, 220-3(Jun 1971). (In German).

Methods described for welding Ni and Ni alloys include fully automatic TIG, plasma-arc, MIG, submerged-arc, and electron-beam techniques. Various aspects, i.e., automation problems, deposition rates, and weld quality, are discussed. The examples given include: TIG spot welding of NiCr15Fe; MIG build-up welding, seam welding, and spot welding with wire electrodes; and MIG build-up welding with strip electrodes. The parameters for producing submerged-arc-welded joints in pure Ni, NiCu30Fe, NiCr15Fe, and NiMo30 using consumables such as S–NiCr20Nb and S–NiCu32Ti are tabulated. Electron-beam welding is particularly suitable for joining age-hardenable heat-resistant alloys with high Ti, Nb, and Al contents. (Metals Abstr.)

15718 METHOD FOR PRODUCING A STAINLESS STEEL RESISTIVE TO HIGH TEMPERATURE AND NEUTRON IRRADIATION. Kondo, Tatsuo; Kikuyama, Toshihiko; Nagasaki, Ryukichi (to Japan Atomic Energy Research Inst.). U. S. Patent 3,623,920. 30 Nov 1971. Filed 17 Mar 1969.

By subjecting a stainless steel of AISI 300 series to cold working of at least 10 percent, and a strain aging at 500 to 800°C, and then to recrystallization treatment at 650 to 950°C, a stainless steel has been obtained that has high-temperature yield strength approximately twice that of the conventional austenite steel of the same composition, is resistant to embrittlement due to high-temperature reactor irradiation, and yet retains its ductility and microstructure stability. (Official Gazette)

15719 SYNTHESIS OF LANTHANIDE–IRON LAVES PHASES AT HIGH PRESSURES AND TEMPERATURES. Cannon, J. F.; Robertson, D. L.; Hall, H. T. (Brigham Young Univ., Provo, Utah). Mater. Res. Bull.; 7: No. 1, 5-11(Jan 1972).

High pressures and temperatures were used to synthesize the previously unknown compounds $PrFe_2$, $NdFe_2$, and $YbFe_2$. These compounds have the cubic $MgCu_2$-type structure with lattice parameters 7.467, 7.452, and 7.239 Å, respectively. The relative importance of 4f bonding and size effects in the formation of LFe_2 compounds (L = lanthanide) is discussed. (auth)

15720 INVESTIGATION OF SOME METHODS OF PREPARATION AND AN EXAMINATION OF SOME PHYSICAL PROPERTIES OF HIGH-PURITY VANADIUM. Beale, Harry Andrew. College Park, Md.; Univ. of Maryland (1971). 318p. University Microfilms Order No. 72-1661.

Thesis.

Several techniques have been investigated to prepare high purity vanadium for physical property determinations. In general, high-purity dendritic crystalline vanadium powder was converted to macroscopic single crystal form. The single crystals were required for plastic deformation studies and also for studying the low field transport properties. Several physical properties were measured to aid in evaluating the various preparation techniques. Shear stress vs shear strain for two orientations was investigated as a function of temperature and purity. In the more pure samples, well-defined Stage II work hardening was observed. Further, no yield drop phenomena were found for temperatures above 273°K. The critically resolved yield stress at 300°K was 0.9 kg/mm^2. The value was 18.8 kg/mm^2 for the more impure vanadium. The hardness of impure polycrystalline samples was monitored as a function of impurity content. Nitrogen was found to have the greatest effect. Oxygen had a lesser effect. The hardness seemed fairly insensitive to carbon content. Samples were analyzed by independent agencies for interstitial impurities. An internal friction analysis, in general, agreed with the chemical analyses. Resistance ratios were measured, with values as high as 655 being recorded. Carbon was found to have the greatest effect on the ratio. Nitrogen was found to have a much lesser effect, with oxygen and hydrogen having even lesser effects. The various experiments indicated that the purification is a many-fold process. Carbon is removed by a true zone refining action. Nitrogen cannot be removed by zone melting, irrespective of the value of the total pressure, though it does move through electromigration at low temperatures. The removal of oxygen is attributed to very low values of the partial pressure of oxygen ($<10^{-11}$ torr) and the presence of a metallic vapor envelope surrounding the molten zone. The metallic envelope prohibits the interaction of the residual oxygen with the molten metal and locally reduces the value of the oxygen partial pressure. Since the activity of oxygen is lower outside the zone, the interstitial oxygen diffuses to the surface where it is gasified. (Diss. Abstr. Int., B) (TSS)

15721 PROCESS FOR PRODUCING COBALT ALLOYS. Herchenroeder, Robert B.; Chow, Joe G. Y.; Fleitman, Albert H. (to United States Atomic Energy Commission). U. S. Patent 3,620,852. 16 Nov 1971. Filed 27 Feb 1970.

A process is given for producing oxygen-free cobalt based alloys having improved stability in high temperature irradiated sodium environment. Cobalt is alloyed with chromium, tungsten, iron, carbon, nickel, molybdenum, and titanium and thereafter the alloy is cold reduced 50% and heat annealed until it has a grain size of less than 10μ. (Official Gazette)

15722 SUCCESSFUL JOINING OF BERYLLIUM. Scott, D. G.; Estes, C. L.; Huber, R. A.; Turner, P. W. (Union Carbide Corp., Oak Ridge, Tenn.). Weld. J. (N. Y.); 51: No. 1, 15-23 (Jan 1972).

Equipment and techniques have been developed for resistance welding 3 to 5-mil thick beryllium foil strips into a honeycomb core. Procedures, demonstrated by dye penetrant and helium leak checking to be highly reliable, were developed for electron beam welding beryllium sheet in the thickness range of 23 to 30 mils. A self-fixturing joint design was used to circumvent problems caused by differential expansion when dip brazing aluminum to beryllium with an aluminum-silicon brazing alloy. The gas metal-arc welding process was used with the aid of a pulsed current for making leak-tight braze welds in 25-mil thick beryllium cylinders. (auth)

15723 FUSION WELDING OF A TUNGSTEN ALLOY TO A TANTALUM ALLOY. Tardiff, George (Univ. of California, Livermore). Weld. J. (N. Y.); 51: No. 1, 36s-40s(Jan 1972).

Various approaches to electron-beam welding a tantalum-base alloy (T-111) to a weldable tungsten-base alloy (W–25 at. % Re–30 at. % Mo) were evaluated. Extreme solid solution strengthening and extensive cracking after cooling were observed in the weld nugget formed by welding the two alloys directly. Braze welding, using fillers of Mo, Nb, and Mo–50 wt % Re, resulted in substantial reductions in weld nugget hardness and reduced cracking somewhat. The cracking is attributed in part to the embrittling effect of rhenium in tantalum. The use of a pure molybdenum transition piece between the T-111 and W–Re–Mo alloy was observed to result in the last fragile weldment partly because alloying between tantalum and rhenium is avoided. This technique would allow the use of weldments between the W–Re–Mo alloy and T-111 in special cases. (auth)

15724 INVESTIGATION OF COMPOUNDS IN THE NIOBIUM–TIN SYSTEM AND SYNTHESIS OF SUPERCONDUCTING Nb_3Sn TAPE. Kunakov, Ya. N. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; 32: 111-15(1970). (In Russian).

Data are given from an investigation of intermediate compounds in the niobium–tin system produced in diffusion layers with annealing in the 600 to 1600°C range. The first results on synthesis of flexible Nb_3Sn superconducting tape are presented. (JPRS)

15725 CUTTING-TOOL SELECTOR: GUIDE TO HIGHER PROFITS [IN METAL-REMOVAL OPERATIONS]. Zlatin, N.; Kahles, J. F. Metalwork. Econ.; 26: No. 5, 46-51(May 1970).

Common grades of high-speed steels, carbides, ceramics, and the new high-strength, fine-grain carbides are tabulated as an aid to the selection of cutting tools. Another table lists the high-speed steels and carbides that are recommended for turning, boring, spot facing, planning, broaching, milling, drilling, reaming, and tapping operations on materials such as C steels, tool steels, cast irons, stainless and maraging steels, Ti alloys, Ni and Co

alloys, Al and Mg alloys, Cu and Zn alloys, and refractory alloys of W, Mo, Nb or Ta. (Metals Abstr.)

15726 METALLURGICAL APPLICATION OF SOLVENT EXTRACTION. II. PRACTICE AND TRENDS. Rosenbaum, Joe B.; George, D. R.; May, Joan T. Information Circular No. 8502. Washington, D. C.; Bureau of Mines (1971). 19p.

New applications and concepts of solvent extraction as a unit operation in extractive metallurgy have been developed in the last decade. Wider use is being made of established solvent extraction techniques in processing spent nuclear fuel elements and in winning Nb–Ta, Hf–Zr, Th, W, U and V. Commercial application has been extended to recovery of Be, B, Br, Cu, Mo, P, rare-earth metals and Re. Systems in use and proposed, typically extract metals or salts as anion, cation, or neutral species from aqueous media by reaction with a recycleable organic reagent. (Metals Abstr.)

15727 EXPERIMENTAL STUDY OF THE CODEPOSITION OF CHROMIUM AND MOLYBDENUM. Fridmann, Claude; Royon, Jean. Bull. Doc., Cent. Inform. Chrome Dur; 46p(Jun 1970). (In French).

Codeposition of Mo with Cr from aqueous solutions containing CrO_3, MoO_3, and H_2SO_4 was favored at high codeposition rates and low bath temperatures. Low CrO_3 : MoO_3 ratio and in particular a high MoO_3 content are desirable. Electrode reactions and efficiencies were determined; the efficiencies were very dependent on the operating conditions and thus so was the bath stability. Various anode materials were investigated, including Mo, Pb–Mo, and Pb–Sb · Pb–Sb or Pb–30% Mo were found to be the most suitable. The deposits showed good adhesion and satisfactory mechanical properties. Bright deposits limited to 1% Mo were obtained at 50°C; up to 4% Mo could be obtained at 20°C, but these deposits were matte type. (Metals Abstr.)

15728 LIQUID-LIKE BEHAVIOR OF VACUUM-DEPOSITED INDIUM FILMS. Barna, A.; Barna, P.; Pocza, J. (Research Inst. for Technical Physics, Budapest). pp 102-7 of Growth of Crystals. Vol. 8. /Sheftal, N. N. (ed.). New York; Plenum Publishing Corp. (1969).

From seventh international congress of crystal growth; Moscow (20 Jul 1966).

In situ experiments were conducted at 10^{-6} and 10^{-7} torr in the electron microscope to study the phase changes occurring in pure In evaporated onto amorphous carbon at 20 to 110°C. The results show that liquid-phase condensation occurs, and that the grains solidify upon exceeding a critical diameter dependent on the substrate temperature. The crystallite shape was determined, and the processes in grain coalescence are discussed. (D.L.C.)

15729 TEMPERATURE DISTRIBUTION IN A SPHERE WELDED BY ELECTRON BOMBARDMENT. THEORETICAL STUDY AND METALLURGIC CONSEQUENCES. Labal, M. (Societe Stein Industrie, Paris); Barbe, B. Soudage Tech. Connexes; 25: No. 9, 399-408(Sep 1971). (In French).

The temperature distribution of a thin sphere, formed by welding two U/Mo alloy hemispheres together, was studied. Two models are suggested which explain the observed phenomena: instantaneous equatorial welding or mobile point source welding. Both interpretations agree well with observations although the point source one is nearer to the reality of the problem. The program developed allows the complete thermal cycle of a point in the sphere, to be examined. From the U–Mo equilibrium diagram and the continuous cooling curves of the alloy (1.5 per cent Mo by weight), it is possible to estimate the width of the molten zone and the different phases present in the zone affected. (France)

15730 DEVELOPMENT OF CONSTRUCTION AND FABRICATION OF PRESSURE VESSELS FOR NUCLEAR POWER PLANTS. Bautechnik; 48: No. 6, 212-13(1971). (In German).

Discussions are presented on aspects of fabrication from a producer's point of view. (INIS)

15731 WELDING BY ELECTRON BOMBARDMENT OF A TUBULAR ASSEMBLY TO THE BASE OF A VESSEL. Peyrot, J. P. French Patent 2,064,562. 28 Jun 1971. Filed 29 Sep 1969. (In French).

A procedure for mounting a multiple tubular assembly, in particular by the electron bombardment welding of two concentric sleeves to the two flat regions of the base of a vessel (e.g., nuclear reactor vessel), is described. (France)

15732 WELDING AND BRAZING FILLER METALS. Slaughter, G. M.; Canonico, D. A. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Des.; 17: No. 2, 181-203(1971).

A description of the welding and brazing filler metals most commonly used in nuclear-oriented applications is presented. The general classes of materials discussed are carbon steels, low-alloy steels, stainless steels, nickel and high-nickel alloys, aluminum, titanium and zirconium, refractory metals, and brazing filler metals. These filler metals are further categorized into the welding process or processes to which they are applicable, that is, shielded metal-arc, gas tungsten-arc, gas metal-arc, submerged-arc, and electroslag. The various factors involved in filler metal selection, such as mechanical properties, service temperature, and corrosion are considered. A discussion of the types of brazing fluxes and atmospheres is also presented. (auth)

15733 WELDING AND AGING OF BIMETALLIC REFRACTORY METAL JOINTS. Phillips, Wayne M. (Jet Propulsion Lab., Pasadena, Calif.). Contract NAS 7-100. pp 1-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A wider scope of refractory metals is presently being considered for application to advanced in-pile thermionic converters, particularly with regard to the types of tungsten being used as substrate for the fuel-emitter clad. To provide additional data on the relative fabricability of these materials and their applicability to bimetallic joint configurations a survey type welding and aging program has been undertaken at JPL. Electron beam welded bimetallic joints have been prepared from five types of tungsten, tungsten/rhenium, rhenium, molybdenum, tantalum and niobium. Initial results indicate that the most weldable types of tungsten are the fluoride vapor deposited material and the thoriated material. Arc cast and chloride vapor deposited tungsten are susceptible to grain boundary cracking in the weld heat-affected-zone. Powder metallurgy products are susceptible to weld porosity. Rhenium while readily welded to itself has been found to be virtually unweldable to any other refractory metal by standard electron beam techniques because of the formation of σ and ξ phases. Niobium was found to be the refractory metal most readily joined to tungsten. Weld joint alloying was effective in reducing Kirkendall porosity formation during subsequent high temperature exposure in all the bimetallic combinations investigated. (auth)

15734 ELECTRON BEAM WELDING OF TUNGSTEN TO TUNGSTEN/RHENIUM AND TUNGSTEN/RHENIUM TO NIOBIUM. Raab, B.; Schock, A. (Fairchild Hiller Corp., Farmingdale, N. Y.). Contract NAS 7-100. pp 7-11 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The assembly of an external-fuel revolver fuel element and converter requires a number of refractory-metal weldments to be made. In particular, the tungsten revolver is sealed by tungsten-rhenium end caps, one on each end. These in turn are welded to the niobium-1% zirconium sleeves of ceramic-metal seals. All of the remaining joints enclosing the diode are niobium-to-niobium welds of a more standard nature. Only limited experience exists in welding to tungsten or tungsten-rhenium, especially in attempting to hermetically seal a fuel body of the size of the tungsten revolver. Also, a reliable transition from the tungsten revolver to the niobium-alumina seal was sought which would not require the introduction of transition materials such as tantalum. Tantalum is more vulnerable to oxidation corrosion than either of the materials to be joined. Empirical solutions were sought which could be readily incorporated into the asembly procedure and tested in actual service. In general, weld specimens were prepared and examined metallographically for most of the critical joints prior to converter usage. All welding was performed on a high-voltage Hamilton Standard electron beam welder. The results of these trials, together with the actual converter assembly results are reported. (auth)

15735 EFFECT OF THE DEPOSITION PARAMETERS ON THE CRYSTAL STRUCTURE OF CVD TUNGSTEN. Shroff, A. M.; Imbert, F.; Roux, F. P.; Clemot, M.; Durand, J. P. pp 58-67 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The study of the deposition parameters of tungsten formed by the reduction of tungsten hexafluoride by hydrogen is of great importance for the preparation of thermionic converter emitters when long life is to be expected. Several failures by short circuit were attributed to coatings. The causes being either bad original adherence of the tungsten on the molybdenum base or to the

presence of microporosities in the layer which tend to grow bigger and bigger when the emitter is heated at high temperature and finally induces damages in the layer structure. Results of studies of the microporosity and how to avoid them by adjusting the deposition parameters in order to have reliable emitters are presented. (auth)

15736 THEORETICAL AND EXPERIMENTAL STUDY OF THE PREFERENTIAL ORIENTATION OF CVD TUNGSTEN. Shroff, A. M.; Imbert, F. pp 68-71 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Tungsten can be deposited by the reduction of tungsten hexafluoride by hydrogen, the reduction of tungsten hexachloride by hydrogen, or the pyrolysis of tungsten hexacarbonyl. All these methods lead to a preferential [100] growth except for the hexachloride which under very particular conditions may lead to [110] preferential orientation. The [110] preferential crystal orientation is of great importance in thermionics, as it would allow either to work at lower temperature for the same output power or to increase the emitter collector gap. A program of work was started in order, first to know what is the physical barrier to the growth of [110] when hexafluoride or carbonyl are used, secondly to set up the experimental apparatus and realize some samples with these two compounds. A working model based on the fact that the adsorbed impurity molecules change the work functions of the substrate and affect the preferential crystal orientation is discussed. (J.R.D.)

15737 USE OF OXYGEN ADDITIVE TO CONTROL RESIDUAL FLUORINE IN CHEMICAL VAPOR DEPOSITED TUNGSTEN. Glaski, Fred A. (Fansteel Inc., Pacoima, Calif.). pp 72-3 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The historical discovery of porosity or "bubbles" in chemically vapor deposited tungsten thermionic emitters, derived from H_2-reduced WF_6, is briefly reviewed. In this regard, correlations are referenced between residual fluorine content and the porosity. The problem is then specifically identified in the laboratory as a retained, non-volatile fluoride compound (WF_4) and the theory for eliminating this compound by oxygen addition to the reactant gases is discussed. Proof of this theory is achieved by presenting extensive supporting data, including a direct relationship between the "additive" concentration in the reactant gas mixture and the analyzed fluorine content in the resulting deposit. Further striking advantages to the use of oxygen "additive" are presented for other fluoride deposition systems besides tungsten, including rhenium, molybdenum, tungsten/rhenium alloys and molybdenum/rhenium alloys. (auth)

15738 CHEMICAL-VAPOR DEPOSITION AND CHARACTERIZATION OF TUNGSTEN–RHENIUM ALLOYS. Federer, J. I.; Schaffhauser, A. C. (Oak Ridge National Lab., Tenn.). pp 74-81 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Tungsten-rhenium alloys have many potential high-temperature applications in nuclear reactors, isotope-powered generators, and thermionic devices. A method has been developed for depositing alloys containing up to 25% Re, although most of the work to be described deals with nominal W–5% Re alloys. The method involves hydrogen reduction of WF_6 and ReF_6 on resistance-heated substrates contained within a water-cooled chamber. The thickness and compositional uniformity of the deposits has been optimized with respect to deposition variables. A minimum temperature of about 700°C was found to be necessary for compositional uniformity since at lower temperatures rhenium was preferentially deposited on the gas inlet end of the deposit resulting in a composition gradient. Compositional uniformity was also favored by pressures of about 10 torr or less. The $H_2/(WF_6 + ReF_6)$ ratio in the range 1 to 30 did not greatly affect compositional uniformity but did affect thickness uniformity, morphology, and grain structure. Deposits prepared with a $H_2/(WF_6 + ReF_6)$ ratio of about 3, the stoichiometric mixture, had greater uniformity of thickness, smoother surface, and finer grain structure than deposits prepared with more hydrogen in the gas mixture. The rhenium and fluorine contents decreased, while the deposition rate increased with total gas flowrate in the range 140 to 1400 cm^3/min. Uniaxial gas flow resulted in nonuniformity of thickness due to gas depletion; therefore, periodic reversals of gas flows to improve the thickness uniformity of sheet deposits were used. Results of annealing studies have shown that nominal 5% Re deposits have much greater grain stability than nominal 25% Re deposits. A W–4% Re alloy with a columnar grain structure had some grain growth, but still retained a columnar grain structure after annealing at 2400°C for 2 h. On the other hand, a W–22% Re deposit completely recrystallized within 100 h at 1600°C. Annealing the W–22% Re alloy at 2400°C for 2 h resulted in an equiaxed grain diameter of 0.5 to 1 mm. (auth)

15739 PREPARATION OF ELECTROETCHED CHEMICALLY VAPOR DEPOSITED TUNGSTEN EMITTERS. Danko, J. C.; Titus, G. W. (General Electric Co., Pleasanton, Calif.). Contract AT(04-3)-771. pp 82-5 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A method of electroetching chemically vapor deposited fluoride tungsten with a preferred (100) crystal orientation to yield thermionic performances characteristic of (110) oriented chloride tungsten is described. The results of electroetching a number of cylindrical emitters from a single piece of chemically vapor deposited fluoride tungsten and the high temperature stability of the electroetched tungsten surface are presented. A comparison of the thermionic performance with that obtained for (110) oriented chloride vapor deposited tungsten is discussed. (auth)

15740 EMITTER AND COLLECTOR SUBLIMED COATINGS. Dunlay, J.; Meyers, R. (Thermo Electron Corp., Waltham, Mass.). Contract AT(30-1-4125. pp 86-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The characteristics of sublimed emitter and collector coatings are described. Planar emitters were prepared with tungsten coatings on tungsten substrates. The bounding surface of the coating is believed to be predominantly (110), independent of the substrate orientation. Test results are presented for a fixed-spacing planar diode using a CVD tungsten-coated emitter. Collector coatings were prepared using molybdenum, nickel, and niobium on niobium substrates. (auth)

15741 OUTGASSING AND ASSEMBLING TECHNIQUES IN A SPECIALISED UHV APPARATUS. Durand, J. P.; Lebourg, R.; Lesueur, R.; Lazare-Choppard, G. (CEN, de Saclay, Gif-sur-Yvette, France). pp 123-7 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Activities in a research program directed toward reduction in the number of fabrication variables during assembly of thermionic converters are reported. Efforts directed toward development of an electron beam welding machine in which the emitter and collector may be outgassed and then welded together without exposure to air are summarized. (J.R.D.)

15742 FORMATION OF (0001) ORIENTED RHENIUM SURFACES BY CHEMICAL VAPOR DEPOSITION. Glaski, Fred A. (Fansteel Inc., Pacoima, Calif.). pp 128-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The pyrolytic decomposition of rhenium chloride is emphasized as the most desirable chemical vapor deposition system. Major deposition parameters are discussed and individually evaluated, and the "best" deposition conditions are summarized. Certain equipment and technique suggestions are included as practical aids to chemical vapor deposition fabricators. (auth)

15743 CHARACTERIZATION OF CVD MOLYBDENUM THIN FILMS. El-Hoshy, A. H. (General Electric Co., Schenectady, N. Y.). J. Electrochem. Soc.; 118: No. 12, 2028-31(Dec 1971).

Transmission electron micrographs, resistance ratios, and x-ray diffraction measurements were used to characterize CVD Mo films for a deposition temperature range from 500 to 800°C and a deposition rate at 700°C that varied between 87 and 350 Å/min. (auth)

15744 INVESTIGATION OF ADSORPTION STRUCTURE WITH THE CHANNEL PLATE FIELD ION MICROSCOPE. Schmidt, W. A.; Frank, O. (Max-Planck-Gesellschaft, Berlin). Ber. Bunsenges. Phys. Chem.; 75: No. 10, 998-1002(Oct 1971). (In German).

Adsorption structures of CO, N_2, O_2, and H_2 on tungsten have been investigated by means of krypton field ionization using a channel plate as an image intensifier. By comparing the FIM images of 77°K adsorption layers with those of the clean surface it can be concluded that the adsorbate remains invisible, although field electron microscopic observations show that at field strengths F < 1V/Å the adsorbate is still present. FEM images of the covered surfaces are the same before and after field ionization. For 77°K adsorption layers of CO, O_2, and H_2 field corrosion occurs. For 300°K adsorption layers of all gases investigated, changes in surface structure appear already without field. The same is valid for the 77°K nitrogen layer which in so far is an exception. The rearranged surfaces found for 300°K layers are somewhat comparable to reconstruction deduced from LEED results. However, to explain phenomena of ionization probabilities found for 77°K adsorption layers, further influences which take care of local field distributions caused by chemical interaction have to be taken into account. (auth)

15745 PROCESS FOR DIRECTLY REDUCING PLUTONIUM DIOXIDE TO PLUTONIUM. Felt, Rowland E. (to United States Atomic Energy Commission). U. S. Patent 3,619,178. 9 Nov 1971. Filed 14 Nov 1969.

Plutonium dioxide is reduced to plutonium metal by adding the plutonium dioxide and calcium to a flux consisting of 5 to 20 weight percent calcium fluoride and 95 to 80 weight percent calcium chloride held at about 800°C. The plutonium dioxide and calcium may be added simultaneously or sequentially; however, the weight of unreacted plutonium dioxide in the flux must never exceed 20 percent of the weight of the flux and no more than a slight excess of calcium may be present in the flux. The plutonium metal is removed to one vessel and the salt removed to another where it is contacted with calcium-30 weight percent zinc to remove residual plutonium therefrom. (Official Gazette)

15746 PREPARATION OF PLUTONIUM METAL. II. PREPARATION OF PLUTONIUM METAL BY CALCIUM REDUCTION OF SODIUM PLUTONIUM(IV) FLUORIDE. Yahata, Taneaki (Japan Atomic Energy Research Inst., Tokai); Muromura, Tadasumi; Ouchi, Kinji; (and others). J. Nucl. Sci. Technol. (Tokyo); 8: No. 12, 682-4(Dec 1971).

A method for producing Pu metal by the reduction of sodium plutonium(IV) fluoride is reported. After the valency of Pu in acidic solution was adjusted to tetravalent state by addition of nitrite (e.g., $NaNO_2$), sodium plutonium (IV) fluoride was precipitated by adding hydrofluoric acid in the presence of sodium ion in the solution. The double salt obtained by the wet method was dried under reduced pressure at 110°C, and then reduced with Ca metal in Ar atmosphere. Over 80% Pu yield was obtained by reducing 1 g batch of the double salt. (auth)

15747 BONDING OF METALS. (to Comitato Nazionale per l'Energia Nucleare). British Patent 1,258,141. 22 Dec 1971. Priority date 3 Jan 1968, Italy.

A process for producing transition joints between dissimilar metals is described. The process provides for joining the metals using a nonbrittle thin interlayer. An example is included in which a two-layer tube composed of stainless steel and Zircaloy is extrusion bonded using a soft iron interlayer. (J.R.D.)

15748 TUNGSTEN NEWS, DECEMBER 1971. Tungsten NEWS; 1-18(Dec 1971).

Research and development activities in W technology are reviewed. Information is included on W metal, WC, W-base alloys, and recovery and processing of W. 349 references are included. (J.R.D.)

15749 BUTTONHEADS FOR TENDON WIRES OF A PRESTRESSED CONCRETE REACTOR VESSEL. Hildebrand, J. F. (Gulf General Atomic Co., San Diego, Calif.). J. Prestressed Concrete Inst.; 16: No. 5, 78-98(Sep-Oct 1971).

Results of investigations and tests directed to establishing acceptance standards for cold-deformed anchorages on tendon wires for use in prestressed concrete structures are discussed. It is noted that high-quality buttonhead anchorages depend on the degree of quality control exercised by the wire manufacturer and the tendon fabricator. Corrections of the buttonhead flash and slip imperfections is contingent on the care and quality control exercised by the machine operator, tendon fabricator, and construction contractor. (J.R.D.)

15750 INFLUENCE OF THE PROCESS SETTINGS ON THE DIMENSIONS OF ZIRCONIUM DEPOSITS ON GRAPHITE. Kravetskii, G. A.; Samosudov, V. V.; Dergunova, V. S. Weld. Prod. (USSR) (Engl. Transl.); 18: No. 3, 49-52(Mar 1971).

Translated from Svar. Proizv.; No. 3, 31-3(1971).

The dimensions of zirconium beads deposited on graphite with consumable and nonconsumable electrodes were investigated in relation to the wire diameter, the welding speed, and the current. The equipment used for coating axially symmetrical components is described. (auth)

15751 METHOD FOR THE EXPLOSIVE WELDING TOGETHER OF TWO METAL PARTS. Golinelli, Paolino; Marengo, Giuseppe; Montagnani, Mario; Verzeletti, Guido (to EURATOM). British Patent 1,259,247. 5 Jan 1972. Priority date 13 Jun 1969, Germany.

A method is described for explosive welding of metallic parts in which an interlayer capable of preventing hydrogen diffusion through the weld is interposed between the parts to be welded. An example is included in which Zircaloy is welded to steel using a gold interlayer. (J.R.D.)

15752 RESEARCH AND DEVELOPMENT WORK AND MANUFACTURING CAPABILITY OF ZIRCALOY TUBES FOR FUEL CLADDING FOR NUCLEAR POWER GENERATION. Kondo, Yutaka (Sumitomo Metal Industries, Ltd., Amagasaki, Japan). Karyoku Hatsuden; 22: No. 5, 528-40(May 1971). (In Japanese).

A review is presented of research and development work and manufacturing capability of Zircaloy tubes. Several products have been delivered; some are now on order from many users in Japan and abroad. Irradiation experiments carried out at Halden Reactor showed good results. Fundamental research started in 1958, followed by construction of pilot plant in 1965 and completion of production plant in 1968 is described. The present production process is composed of special melting methods, iterative vacuum melting, special heat treatment during forging, extruding with copper cladding, cold rolling with high geometrical precision, and special finishing. Present quality control is featured by strict control of composition, defects, and geometry at stages involving raw material, ingot, billet, extruded tubes, and cold rolling of tubes. Final products have to undergo rigid inspection and examination. The company is capable of providing products with various strength and ductility, by controlling content of oxygen and conditions of cold rolling and annealing. The hydride orientation index (Fn) of produced tubes is extremely small due to adoption of rolling of large thickness reduction in finishing process and removal of residual stress. Other required properties such as corrosion resistance and dimensional accuracy are realized by methods developed by the company. An ultrasonic defect detection technique with high sensitivity has been developed, and the entire circumference and length of all products are checked for defects. (Japan)

15753 ELECTRODEPOSITED COATINGS. Mock, J. A. Mater. Eng.; 73: No. 3, 40-7(Mar 1971).

A basic guide to electroplating with various metals is presented, including zinc, cadmium, and lead. Coating properties and performance are discussed and details are given of design considerations and different types of plated metal coatings on various substrates. Copper–nickel–chromium and microcracked chromium on zinc and zinc alloy substrates are also considered. (Corrosion Abstr.)

Properties, Structure, and Phase Studies

Refer also to abstracts 14815, 15114, 15171, 15348, 15568, 15858, 16118, 16809, 16815, 16818, 16820, 16831, and 16834.

15754 (CONF-680614–, pp 41-58) CURRENT METALLOGRAPHIC PRACTICES ON PLUTONIUM-RICH PLUTONIUM–HAFNIUM ALLOYS. Shadden, V.; Land, C. C. (Los Alamos Scientific Lab., N. Mex.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The plutonium–hafnium phase diagram is under current investigation at LASL. The metallography of the plutonium-rich alloys of this system is challenging because of the existence at room temperature of two intermetallic compounds and two metastably retained allotropes of plutonium (β and δ–Pu). The procedures used in preparing the specimens for optical metallography, diffractometry, and hardness testing are described. (auth)

15755 (CONF-680614–, pp 59-63) ELECTRON MICROPROBE EXAMINATION OF Pu–Al ALLOYS. Harvey, M. R.; Riefenberg, D. H.; Smith, C. J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Studies were made to determine if alloys and intermetallic compounds in the Pu–Al system could be correlated with the empirical Ziebold–Ogilvie equation $(C_A/K_A) = a_{AB} + (1 - a_{AB})C_A$ where C_A is the concentration (weight fraction) of element A, K_A

is the observed intensity of A relative to pure A, and a_{AB} is the conversion parameter (assumed constant) for element A in the alloy. The conversion parameters of Al and Pu for the microanalyzer used were determined also. The results showed that the data can be correlated with the Ziebold–Ogilvie equation. The data indicate a very strong absorption effect which is not predicted by mass absorption data. It was concluded that the Ziebold–Ogilvie method must be used to obtain accurate analyses of Al in Pu–Al alloys. (P.C.H.)

15756 (CONF-680614–, pp 153-61) SIMPLIFIED METALLOGRAPHIC TECHNIQUE FOR BERYLLIUM. Calabra, Arthur E.; Marts, Don L.; Capes, James F. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A simplified metallographic technique for vacuum-cast rolled ingot beryllium sheet and powder pressed beryllium has been developed. This technique is such that the beryllium metallographic specimen needs only to be ground through 600-grit (soft) silicon carbide paper and electrolytically polished. This simplified technique yields polarized light delineation of the microstructure; however, inclusions are not retained. Another technique, more precise than the simplified technique, is described for the preparation of high quality metallography of powder pressed material. (auth)

15757 (CONF-680614–, pp 168-93) QUANTIMET TELEVISION MICROSCOPE: ITS OPERATION AND EVALUATION. Kegley, T. M. Jr. (Oak Ridge National Lab., Tenn.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

The operation and performance of the Quantimet Television Microscope in metallographic work are described. The Quantimet is an electronic instrument which by analyzing the output from a television vidicon tube is able to rapidly measure the area and projection of images projected onto the vidicon tube from either a microscope or an epidiascope. The evaluation of the Quantimet included grain size analysis of ASTM standard grain size charts and area analysis of known area-fraction charts. Point count and Quantimet area analyses were made from the same nickel–bakelite compact and results compared with density measurements. Examples of the application of the Quantimet included area fraction measurements of ferrite in stainless steel weld metal, porosity in pyrolytic tungsten, UO_2 in a stainless steel–UO_2 fuel element, and voids in UO_2 particles. (T.F.D.)

15758 (COO-1676-18) DISLOCATION-SOLUTE ATOM INTERACTIONS IN ALLOYS. Technical Progress Report. Gibala, R.; Ulitchny, M. G.; Klems, G. J.; Sagues, A. A.; Vasudevan, A. K. (Case-Western Reserve Univ., Cleveland, Ohio). 31 Oct 1971. Contract AT(11-1)-1676. 39p. Dep. NTIS.

Developments are reported for studies on: internal friction of ferrous martensites; alloy hardening and softening in Nb and Ta base interstitial solid solutions; anelasticity of bcc refractory metals; and alloy hardening and softening in Nb–Mo and Nb–Mo–O alloys. The results showed that the Fe–Ni–C alloys are characterized by a highly twinned martensite with a 160°C relaxation peak. It is believed that the twinned structure and morphology play the key role in the relaxation mechanism of the 160°C peak. In the second study, the results showed that a large part of the alloy softening that occurs in the Group Va metals containing interstitial impurities can be attributed to solute association. The results of anelasticity studies on Ta–Re–N alloys showed that the N peak at ~340°C was decreased in height and broadened on the high-temperature side in a regular fashion by the addition of Re until at 3.8% Re a definite hump was observed at 380°C. In the last study, high purity Nb–Mo alloys showed only alloy hardening at all test temperatures. Ternary alloys of Nb–Mo–O showed alloy softening at low temperatures and low oxygen concentrations. The results may be interpreted in terms of effects that substitutional-interstitial interactions have on localized and thermally activated point defect hardening. (P.C.H.)

15759 (LBL-180) HEAT CAPACITY OF IRON AS A FUNCTION OF PRESSURE AND TEMPERATURE. Yee, Albert Fan (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1971. Contract W-7405-eng-48. 82p. Dep. NTIS.

Thesis.

A technique for the measurement of heat capacity of metals under high pressure is described. Constant current μsec pulses are used to heat the sample and the temperature rise is calculated from the change in resistance. A newly developed constant current pulse generator is described. C_p of iron was measured from 110 to 260°K and from 25 to 75 kbar. A slight decrease in C_p with pressure was noted. The increase in Debye temperature was calculated to be 4.5°K. A P–V isotherm was used to calculate the Gruneisen equation of state, $P = (-dE_0/dV) + (0.45/V)(E - E_0)$. Two gamma angular correlation distribution curves from positron annihilation in ytterbium metal were taken at nine different pressures that ranged from 1 atm. to 80 kbar. There was special interest in the region of the fcc to bcc phase transition at 40 kbar. The observed increase in the widths of the measured curves with pressure could be entirely accounted for by the decrease in the volume of the metal with pressure. This indicates that the high pressure bcc phase of Yb has only two conduction electrons per atom. (auth)

15760 (MLM-1846) HELIUM PERMEATION THROUGH TANTALUM METAL. Kershner, C. J. (Mound Lab., Miamisburg, Ohio). 3 Jan 1972. Contract AT(33-1)-Gen-53. 26p. Dep. NTIS.

The permeation of helium through tantalum metal was determined over a temperature range of 1900 to 2200°C and for pressure differentials of from 2 to 755 torr. The permeability was observed to follow a linear pressure isotherm, and the temperature dependency was found to be of the Arrhenius type with an activation energy of 99.6 ± 4.8 kcal/mole^{-1}. The diffusivity and solubility of helium in tantalum at 2000°C were found to be 3×10^{-6} cm^2/sec and 3×10^{-8} atoms cm^{-3} torr^{-1}, respectively. A reasonable agreement was observed between these measured parameters and those calculated on the basis of a theoretical model of an interstitial trapping and migration mechanism for helium atoms in the body-centered cubic tantalum lattice. (auth)

15761 (ORNL-4681) HEAVY-SECTION STEEL TECHNOLOGY PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1971. (Oak Ridge National Lab., Tenn.). Dec 1971. Contract W-7405-eng-26. 100p. Dep. NTIS.

Progress is reported on the Heavy-Section Steel Technology (HSST) Program. This program was initiated for the purpose of investigating the effects of flaws, variations of properties, stress raisers, and residual stress on the structural reliability of present and contemplated water-cooled reactor pressure vessels. Information is presented on program administration and procurement, investigations of irradiated and unirradiated materials, and pressure vessel investigations. (R.C.K.)

15762 (RFP-1652) TRANSFORMATION KINETICS AND MECHANICAL PROPERTIES OF THE URANIUM-7.5 NIOBIUM-2.5 ZIRCONIUM TERNARY ALLOY. Jackson, Ross J.; Boland, Joseph F. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 21 Dec 1971. Contract AT(29-1)-1106. 13p. Dep. NTIS.

Tensile and impact test data are presented for the U-7.5 wt % Nb-2.5 wt % Zr ternary alloy in the gamma quenched and aged conditions. The mechanical test data are correlated with metallographic and x-ray studies. These alloys, although transition-phase, supersaturated solid solutions, are weakest in the as-quenched condition. Aging the alloys for up to 80-hour periods at temperatures below 400°C results in a noticeable increase in strength with no loss in supersaturation. The data are interpreted in terms of plastic deformation occurring by the motion of twin interfaces and in the pinning of twin interfaces by ordering on aging. A wide variety of mechanical properties are available from this heat treatable and corrosion-resistant alloy, and it shows promise as an economic, high-density, engineering material in both nuclear and non-nuclear applications. (auth)

15763 (SCL-T-710330) SINTERED REFRACTORY TUNGSTEN ALLOYS. Kieffer, R.; Sedlatschek, K.; Braun, H. Translated for Sandia Labs., Livermore, Calif., from Z. Metallk.; 50: 18-24(1959). 19p. Dep. NTIS.

The special position of tungsten on the basis of its high melting point and its position in the periodic system is pointed out. The alloys of tungsten with some metals of Groups IVa to VIIIa are discussed. After a literature review, an account is given of qualitative experiments on the tungsten side in the systems with titanium, zirconium, and chromium, the addition of the alloying metal amounting to 1 to 10%. The tungsten–vanadium system, not previously investigated, appears on the basis of the melting curves and lattice parameters to be similar to the molybdenum–chromium system. The tungsten–niobium and tungsten–tantalum systems are treated in more detail, and the technological properties of the alloys such as density, hardness, specific electrical resistance, and corrosion behavior are described. (auth)

15764 (SRO-552-9) QUANTITATIVE DETERMINATION OF THE STRUCTURE-PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly Progress Report, June 16–September 15, 1971. Rhines, F. N.; DeHoff, R. T.; Whitney, E. D. (Florida Univ., Gainesville. Engineering and In-

dustrial Experiment Station). Oct 1971. Contract AT(38-1)-552. 31p. (ORO-4212-9). Dep. NTIS.

Continued experimental progress has been achieved in the areas of quantitative microstructural analysis, gas permeability studies, short time mechanical properties, high temperature creep, and thermal conductivity measurements. In addition, improvements have been realized in uranium dioxide specimen fabrication techniques through the completion and successful operation of a hot pressing apparatus. Knowledge of the general dependence of mechanical properties upon geometric state has been extended and strengthened as a result of studies of the relationship between interparticle fracture areas and extent of creep in nickel sinterings, and through analysis of fracture type as related to density in sintered uranium dioxide bodies. (auth)

15765 (UCRL-Trans-10567) INFLUENCE OF PRESSURE ON THE Pu-Ga PHASE DIAGRAM. Roux, C.; le Roux, P.; Rapin, M. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from J. Nucl. Mater.; 40: No. 3, 305-10(1971). 10p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 52382.

15766 (USC-113-P-22-2) EFFECTS OF ELECTRIC AND MAGNETIC FIELDS, SUBSTRATE TEMPERATURE, PRESSURE, AND EVAPORATION RATE ON THE NUCLEATION, STRUCTURE, AND RESIDUAL PROPERTIES OF VAPOR DEPOSITED METAL FILMS. Annual Progress Report No. 2, April 1, 1970-March 31, 1971. Murr, Lawrence E. (University of Southern California, Los Angeles. Electronic Sciences Lab.). Nov 1970. Contract AT(04-3)-113. 34p. (USCEE-399). Dep. NTIS.

The effects of electric fields (0-1500 V/cm) applied perpendicular to and in the plane of the substrate, and a magnetic field (0 to 2 kilogauss) applied perpendicular to the substrate have been shown to be negligible on the nucleation and growth of vapor-deposited films of Pd, In, Fe, Co, and Ni. By comparison, substrate temperature, pressure, and evaporation rate have been observed to have a controlling influence on the epitaxy and structure of vapor-deposited Pd, In, Fe, Co, and Ni. A technique has been developed for the quantitative measurement of epitaxial growth based upon 100% for single-crystal films. Results obtained for palladium thin films have shown that the degree of epitaxy increases with substrate temperature, vacuum, and evaporation rate for flash-evaporation rates between approximately $1-3\times10^3$ Å/sec. During the course of investigations of electric and magnetic fields on the nucleation of vapor-deposited metal films, it was observed that with or without an applied field, the geometry, distribution, and crystallography of nuclei in Pd, Fe, Co, and Ni were similar, while those for In were decidedly different. Detailed studies of nucleation and growth of In films compared with Pd, Fe, Co, and Ni have indicated that the thermodynamic (principally melting point) differences between In and the other metals are responsible for the characteristic nucleation. The results suggest that a detailed investigation of vapor-deposited metals over a wide range of melting points could shed some light on the fundamental properties of nucleation and the structural nature of nuclei. Preliminary investigations are outlined where the atomic nature of nuclei is observed in the field-ion microscope. An experimental field-ion microscope design is outlined, and preliminary results of vapor-depositing Pd films onto W emission tips outside the field-ion microscope are reviewed. These results suggest a powerful approach to gaining direct insight into the nature of thin film vapor-deposition through combined observations of nucleation by transmission electron microscopy and field-ion microscopy. (auth)

15767 DIFFUSION PROCESSES IN THE ZONES OF Ti-Nb AND Ti-Nb-Ti JOINTS. Polyanskii, V. M.; Podgorskii, B. N.; Makarovets, O. D. Weld. Prod. (USSR) (Engl. Transl.); 18: No. 3, 14-16(Mar 1971).

Translated from Svar. Proizv.; No. 3, 9-10(1971).

It is shown on the basis of metallographic and x-ray spectrographic evidence that in the Ti-Nb system, notably in two-component assemblies, Nb diffuses into Ti. The mutual diffusion constant for the Ti-Nb system has been determined in relation to concentration. It is shown that the maximum $\bar{D}$ value occurs at 7% Nb. The ring mechanism of diffusion is assumed for metals with the bcc structure. On this basis, the experimental evidence for the preferential diffusion of Nb in Ti and the variation of $\bar{D}$ with concentration can be interpreted in terms of the effects of temperature and concentration on the shear moduli of Ti-Nb alloys. Quantitative data are presented on the diffusion zone sizes in OT4-NP13-OT4 assemblies, as a function of their heat treatment, together with Nb distribution data on joints in this material. It is shown that the x-ray spectrographic approach is useful in the selection of welding techniques for high-performance joints in three-component assemblies. (auth)

15768 DEFORMATION AND TWINNING OF MAGNESIUM AND MAGNESIUM-CADMIUM POLYCRYSTALS AT ROOM TEMPERATURE AND 77°K. Reh, B.; Hoetzsch, G. (School of Mining, Freiberg, Ger.). Phys. Status Solidi (a); 8: No. 2, 423-32(16 Dec 1971). (In German).

The deformation mechanisms of polycrystalline magnesium and magnesium with 10 at. % cadmium were investigated using metallographic surface observations. The orientation of individual grains of these materials was determined by a microbeam Laue x-ray technique. Basal slip and $\{10\bar{1}2\}$ twinning were found to be the main mechanisms of plastic deformation at 77°K and room temperature. (auth)

15769 METAL DESTRUCTION CAUSED BY FOCUSED LASER RADIATION. Zhiryakov, B. M.; Rykalin, N. N.; Uglov, A. A.; Fannibo, A. K. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 5, 815-19(Nov 1971).

Translated from Zh. Tekh. Fiz.; 41: No. 5, 1037-42(May 1971).

Experimental results concerning the interaction between pulsed or quasistationary laser radiation and several metals are described. The shielding of the incident radiation by liquid droplets in the interaction zone is considered. Vapor formation on contamination centers in the bulk of the material plays a role in the dynamics of the metal destruction process. (auth)

15770 THERMAL CONDUCTIVITY OF LANTHANUM. Oskotskii, V. S.; Smirnov, I. A. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 6, 1369-73(Dec 1971).

Translated from Fiz. Tverd. Tela; 13: No. 6, 1635-41(Jun 1971).

A theoretical analysis was made of experimental data on the thermal conductivity of the crystal lattice of lanthanum in relation to temperature over the range 100 to 460°K. Data for two specimens were considered: (1) La with a negligible impurity content and (2) La with a significant content of the paramagnetic rare-earth ions of neodymium and cerium. The thermal conductivity of (1) La can be well represented in terms of the scattering of phonons by three-phonon collisions and by conduction electrons, while a mechanism of phonon scattering at transitions that arise from changes in the orientation of the total moment of the paramagnetic ions in the crystal field is used to describe the thermal conductivity of (2) La. (auth)

15771 ELECTROMOTIVE FORCE STUDY OF THE STATE OF DYSPROSIUM IN LIQUID GALLIUM. Serebrennikov, V. V.; Perov, E. I.; Shkol'nikova, T. M.; Novozhenov, V. A. (Tomsk State Univ., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 6, 790-2(Jun 1971).

Translated from Zh. Fiz. Khim.; 45: No. 6, 1395-8(Jun 1971).

The partial thermodynamic quantities and activity coefficients of dysprosium in liquid alloys with gallium have been determined in the range 500 to 700°C from the experimental emf's of a concentration cell. The calculated Gibbs free energy, enthalpy, and entropy of formation of $DyGa_2$ at 600°C are respectively -41 kcal $mole^{-1}$, -98 kcal $mole^{-1}$, and -68 eu. An intense interaction with a negative deviation from ideality has been discovered in liquid dysprosium-gallium alloys. (auth)

15772 EFFECT OF ALUMINUM AND MOLYBDENUM ON THE PROPERTIES OF SINTERED TITANIUM AT ROOM AND ELEVATED TEMPERATURES. Fedorchenko, I. M. Sb. Tr., Vses. Nauch.-Issled. Proekt. Inst. Titana; No. 6, 111-16(1970). (In Russian).

Ti-Al, Ti-Mo, and Ti-Al-Mo alloys were prepared by mechanically mixing the powdered metals, pressing, and sintering, and then mechanical tests were carried out on the alloys at room temperature and at 300°C. They had an ultimate tensile strength $\leq$80 kg/mm^2 and an elongation of 5 to 16%. Alloying additions of Al and Mo raised the creep resistance, the short-term strength at 300°C being more than doubled. The alloying also caused a significant increase in the long-term strength (creep limit). (Referativnyi Zh.)

15773 NEW CONCEPT ON THE SHAPE MEMORY EFFECT IN METALS AND ALLOYS. Nagasawa, A. (Osaka City Univ.). Phys. Status Solidi (a); 8: No. 2, 531-8(16 Dec 1971).

The shape memory effect is investigated on many kinds of materials undergoing the martensite transformation. The present experiment proves that such metals and alloys as Co, Ti, Zr, Co-Ni, Cu-Al, Fe-Ni, and In-Tl exhibit the shape memory effect. From these results and considerations on the plastic deformation of material containing martensite phase, it

is concluded that the shape memory effect is an inherent thermomechanical property of the martensite transformation. (auth)

15774 THORIUM PHASE DIAGRAMS. Carlson, O. N.; Stevens, E. R. (Ames Lab., Iowa). Nucl. Eng. Des.; 17: No. 3, 439-46(1971).

The binary alloy systems of thorium have received a considerable amount of attention in recent years. Emphasis has been on improvement of the strength and corrosion resistance of thorium as well as the determination of its compatibility with other materials. The phase relationships for those systems of importance to fuel element fabrication or other reactor applications are summarized herein. The USAEC Report IS-1752 has more complete information on phase diagrams of thorium. (52 references) (auth)

15775 THERMODYNAMIC ESTIMATE OF STACKING FAULT ENERGY OF TRANSITION METALS. Skorokhod, V. V.; Solonin, Yu. M. (Inst. of Problems in Material Handling, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 10, 945-8(Oct 1971). (In Ukrainian).

A structure change in the stacking fault region is considered in fcc, bcc, and hcp metals. It is shown that an estimate of the stacking fault energy may be reduced to consideration of a relative stability of fcc, bcc, and hcp structures of transient metals. Theoretically calculated γ_{theor} is in satisfactory agreement with the experimental data. (auth)

15776 VOID MARKER MOTION DURING ELECTROMIGRATION IN Sn–In THIN FILMS. Ohring, M.; Sun, P. H. (Stevens Inst. of Tech., Hoboken, N. J.). Thin Solid Films; 8: No. 6, 455-64(Dec 1971).

A simple electromigration experiment is described in thin pure Sn film stripes alloyed with In over a small central region. At the cathode interface between the pure Sn and the Sn–In alloy regions, voids form and serve as a convenient marker. Similarly at the anode interface hillocks form. With time the void marker front extends into the alloy region with a constant velocity equal to $\sim 1.8 \times 10^{-3}$ cm/sec at room temperature. The results are interpreted in terms of a model involving mass transport across a moving boundary and exact time-dependent solutions are derived. Provided drift in the electric field is larger than transport by chemical diffusion, the marker velocity is predicted to be constant. Depending upon whether $D_{II}Z^*_{II}\rho_{II} > D_I Z^*_I \rho_I$ or the reverse, voids form either at the cathode interface (as observed in Sn–In) or at the anode interface (as in Al–Cu) respectively. Regions I and II refer to the pure and alloy regions while D_i, Z^*, and ρ_i refer to the appropriate vacancy diffusivities, effective valences and lattice resistivities. It is unfortunately impossible to disentangle unambiguously the effects of alloying on D_i and Z_i^* separately by merely noting the position of the marker front. (auth)

15777 CRITICAL RESOLVED SHEAR STRESS OF ALLOY SINGLE CRYSTALS CONTAINING PRECIPITATES. Gerold, Volkmar (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 62: No. 11, 796-801(Nov 1971). (In German).

Theoretical concepts and experimental results are summarized on the problem of the critical resolved shear stress (CRSS) of single crystals containing dispersions of a second phase. First, the case of undeformable particles which are by-passed by dislocations (Orowan mechanism) is discussed. The effective dislocation line tension controlling this mechanism depends logarithmically on the particle size. For small particles the CRSS of the cutting mechanism is markedly below the value of the Orowan mechanism. But, for particle radii of the order of 100 Å overlapping occurs. The interaction force, K, between particle and dislocation increases with particle size. (auth)

15778 PHASE EQUILIBRIA IN THE ALUMINUM–MOLYBDENUM SYSTEM AT TEMPERATURES ABOVE 1400°C. Rexer, Juergen (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 62: No. 11, 844-8(Nov 1971). (In German).

In the aluminum-molybdenum system two high-temperature phases with the compositions $Al_{63}Mo_{37}(\zeta_1)$ and $AlMo(\zeta_2)$ were found between the two phases Al_8Mo_3 and $AlMo_3$, which are known already. The ζ_2-phase has an A2-type structure with a lattice parameter ranging from 3.098 to 3.089 Å. The homogeneity ranges of the intermetallic phases as well as the phase equilibria associated with the two high temperature phases were determined. For the maximum solubility of aluminum in molybdenum the relation $C_{max} = 2.11 \times \exp(-5400/T)$ was found. Concentration measurements on aluminum-molybdenum diffusion couples showed for the regions of existence of the intermetallic phases molybdenum concentrations, which were in part considerably higher than those found in the samples brought into equilibrium. A value larger than 5×10^{-7} cm^2/sec was estimated for the chemical diffusion coefficient of the ζ_2-phase at 1600°C. (auth)

15779 THERMODYNAMIC INVESTIGATIONS IN THE SYSTEM NIOBIUM–MOLYBDENUM–NITROGEN. I. EXPERIMENTAL: NITROGEN SOLUBILITY AND NITROGEN SOLUBILITY LIMIT. Hoerz, Gerhard; Steinheil, Edkart (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 62: No. 11, 849-57(Nov 1971). (In German).

In the system Nb–Mo–N the equilibrium nitrogen concentration as a function of pressure (10^{-4} to 5×10^2 torr), temperature (1600 to 2400°C) and Mo-concentration (0 to 100 at. %) for the range of the ternary α-Nb–Mo–N solid solution has been measured; the solubility limit of nitrogen in the α solid solution has been determined as a function of temperature (1600 to 2100°C) and Mo-concentration (0 to 80 at. %). In addition the kinetics of the dissolution of nitrogen in the α solid solution has been determined. These investigations have been carried out using a gravimetric method and thin disc shaped specimens which were heated by induction. The following results were obtained: (1) The equilibrium nitrogen concentration in the α solid solution obeys the Sieverts' $\sqrt{p}$ law and decreases by 3 to 5 orders of magnitude, when the Mo concentration is increased from 0 to 100 at. % at constant pressure and temperature. (2) The reaction of the nitrogen dissolution is temperature-independent for 80 at. % Mo, exothermic for Mo-concentrations below 80 at. % and endothermic above 80 at. % Mo. (3) The saturation concentration of nitrogen in the α solid solution decreases between 0 and 80 at. % Mo by 1 to 2 orders of magnitude, depending on the temperature, while the corresponding equilibrium nitrogen pressure increases by several orders of magnitude. (4) The β-nitride in equilibrium with the saturated α solid solution has the hexagonal structure of the subnitride Nb_2N up to Mo-concentrations of at least 30 at. %. (5) The initial rate of nitrogen dissolution for constant values of pressure and temperature decreases by about 2 orders of magnitude between 0 and 100 at. % Mo. In the system Nb–N the rate determining step is the dissociation of the nitrogen molecules and chemisorption of the nitrogen atoms. (auth)

15780 STRUCTURAL MATERIALS FOR NUCLEAR REACTORS. Dressler, Gert; Ruehle, Manfred; Westphal, Herbert. Metallges., Rev. Activ.; No. 13, 41-9(1970).

A detailed description of various alloys (Zircaloys, austenitic Cr–Ni steels, Ni, V, Mo, and Cr alloys) used in the construction of nuclear reactors is presented. (Metals Abstr.)

15781 METALLURGY OF ZIRCONIUM. Douglass, D. L. (Univ. of California, Los Angeles). At. Energy Rev.; Suppl. 1971, 1-470(1971).

A systematic exposition of the major problems relating to the metallurgy of Zr and its alloys, as dealt with during the period up to 1970 in over 700 references covering articles, reports, and conference and symposium proceedings is presented. The titles discussed include: crystallography; deformation and textures; physical properties; recovery, recrystallization, and grain growth; theory of alloying; phase equilibria; phase transformations and precipitation in alloys; mechanical properties; diffusion; radiation effects; corrosion; and oxidation. (719 references) (P.C.H.)

15782 QUANTUM DISCUSSION OF DISLOCATION MOTION. Braudy, Robert S.; Kenig, M. Jerry (Drexel Univ., Philadelphia). Scr. Met.; 5: No. 10, 921-32(Oct 1971).

A description of dislocation motion in metals is presented in which precepts of quantum mechanics are used. Results are discussed and interpreted as implying that dislocations should travel at velocities very nearly equal to elastic velocities. Energy bands are shown to be associated with activatable dislocation line segments. Zero point energies, which constitute a weak function of segment length, are associated with the energy bands. (J.R.D.)

15783 SUITABLE ALLOYS FOR BRAZING TITANIUM HEAT EXCHANGERS. Howden, D. G.; Monroe, R. W. (Battelle Columbus Labs., Ohio). Weld. J. (N. Y.); 51: No. 1, 31-6(Jan 1972).

Studies were made on the preliminary feasibility of brazing candidate Ti alloys, and the economics and thermal effects of substituting Ti for the more conventional Al alloys were assessed. The results showed that Ag-based filler metals possess excellent flow and fillet formation on Ti. Nevertheless, they are unsuitable for a heat-exchanger application on the basis of joint embrittlement and low corrosion resistance. The Ti–Ni–Cu alloy has mediocre flow characteristics but provides excellent corrosion resistance and produces strong joints. The Ti–Zr–Be alloy has good flow characteristics and produces minimal base-metal erosion. Both Ti-based alloys could be used for the brazing of high-humidity heat exchangers using either CP Ti or Ti–5 Al–2.5 Sn base metal. (P.C.H.)

15784 FIELD-ION MICROSCOPIC STUDY OF ANTIPARALLEL TWINS IN Ni_4Mo. Chandrasekharaiah, M. N. (Banaras

Hindu Univ., India); Ranganathan, S.; Okamoto, P. R.; Thomas, G. Mater. Res. Bull.; 7: No. 1, 13-17(Jan 1972).

Ni_4Mo undergoes an order-disorder transformation giving rise to three types of domain boundaries. The field-ion image contrast from one such interface, namely the antiparallel twin boundary, has been studied using computer simulation. Evidence is presented for this effect from the field-ion images of Ni_4Mo. (auth)

15785 TEMPERATURE DEPENDENCE OF THE RESISTIVITY AND THERMOPOWER IN SOME POLYVALENT LIQUID METALS. Evans, R. (Univ. of Bristol, Eng.). Phys. Chem. Liquids; 2: No. 4, 249-62(Oct 1971).

Calculations of the temperature dependence of the resistivity and thermopower of liquid indium, cadmium, thallium, lead, and mercury are presented. The values of the thermopower are in better agreement with experiment than the results of previous calculations. The success and validity of the Ziman nearly-free-electron theory are discussed in connection with the results for the resistivity. (auth)

15786 SOME PROPERTIES OF BERKELIUM METAL AND THE APPARENT TREND TOWARD DIVALENT CHARACTER IN THE TRANSCURIUM ACTINIDE METALS. Fahey, J. A. (Univ. of Tennessee, Knoxville); Peterson, J. R.; Baybarz, R. D. Inorg. Nucl. Chem. Lett.; 8: No. 1, 101-7(Jan 1972).

The ^{249}Bk used in the studies described was prepared by reduction of BkF_3 with Li metal at ~1000°C using a Ta crucible system. Physical properties discussed include melting point, phase transformations, volatility, metallic radius, etc. Amongst findings are that the volatilities of Am, Cm, Bk, and Cf metals at their temperatures of preparation increase in the order Cm, Bk, Am, Cf; also that the difference in metallic radius of Bk metal (1.76_7Å, fcc; 1.70_4Å, dkcp) reported earlier may be attributed to slightly differing metallic valencies in the two allotropes, although the values ~2.8 and ~3.2 correspond better with the present observations that Bk is predominantly a trivalent metal. In any case it appears certain that the transformation from one metallic phase of Bk to the other involves only a slight valency change, in addition to the necessary migration of atoms. It is considered that the low melting point of Bk metal, taking into consideration the apparent high volatility of Cf metal, is suggestive of a trend in the heavier actinides. The behavior of Bk is in some ways analogous to that of Sm metal, which precedes the "divalent" metal Eu in the lanthanide series. Sm has a slightly depressed melting point and is notably volatile, but exhibits "trivalent" character in every other respect. This analogy may point to an early onset of "divalent" character in the heavier actinide metals. It also appears that the properties of Bk metal do not correspond with those of Tb, its lanthanide analogue. Some details are given of the preparation of Bk hydride and the possible formation of BkO. (UK)

15787 REGULARITIES OF RECRYSTALLIZATION KINETICS IN METAL MONOCRYSTALS OF VARIOUS DEGREES OF PURITY. Belyakova, M. N.; Zasimchuk, E. E. (Inst. of Metal-Physics, Kiev). Fiz. Metal. Metalloved.; 31: No. 5, 982-93 (May 1971). (In Russian).

The kinetics of crystal formation and growth were studied for a series of monocrystals of metals which included Cu, W, Ni–Mo, Ni–Ti, Nb, Ni, and Mo. The results were evaluated in terms of the purity of the sample and the conditions of deformation, obtained by a statistical microstructure method. The impurities in the matrix do not change the character of the kinetics but significantly retard the process of crystallization of monocrystals. (K.S.W.)

15788 BROADENING OF X-RAY DIFFRACTION LINES OF DEFORMED METALS. Vorob'ev, G. M.; Turba, N. N.; Gaivoronskaya, T. Z. (Inst. of Metallurgy, Dnepropetrovsk, USSR). Fiz. Metal. Metalloved.; 31: No. 5, 994-1003(May 1971). (In Russian).

Angular and wave dependence of the diffusion of lines of the x-ray diffraction spectra of Ni and Nb was found to be almost identical. The absence of line broadening for deformed Ni and Nb was explained by the smallness of the broadening of diffraction lines because of the degree of dispersion of the units. (K.S.W.)

15789 SIGN ORIENTATION OF DISORIENTATIONS FOR PARALLEL SUBBOUNDARIES. Vinnikov, L. Ya.; Pankova, M. N.; Utevskii, L. M. Fiz. Metal. Metalloved.; 31: No. 5, 1018-23(May 1971). (In Russian).

An electron microscopy investigation was conducted of the polygonal structure of the alloy Fe–30% Ni–2% V following hot deformation. The disorientation of neighboring subgrains was studied by the dark-field method. The sub-boundaries, as a rule, produced a relative deflection of neighboring subgrains which more or less compensated the deflections produced by neighboring sub-boundaries. The structural reasons for thermal and mechanical stability of the polygonal structure are discussed. (K.S.W.)

15790 TEMPERATURE DEPENDENCE OF THE FREE SURFACE-ENERGY OF TUNGSTEN. Dranova, Zh. I.; D'yachenko, A. M.; Mikhailovskii, I. M. (Odessa State Univ. Physical-Technical Inst., Moscow). Fiz. Metal. Metalloved.; 31: No. 5, 1108-11(May 1971). (In Russian).

The free surface energy of acicular microcrystals derived from 99.9% purity W wire was studied in the field-emission ion microscope as a function of temperature. The free surface energy fell linearly from 5200 to 3900 erg/cm^2 on raising the temperature from 1200 to 2000°K. Thermal-diffusion effects became appreciable at 2000°K and were responsible for a preferential development of faces with low Miller indices. (Metals Abstr.)

15791 INFLUENCE OF CARBON AND ZIRCONIUM CARBIDE ADDITIONS ON THE COLD BRITTLENESS OF CAST MOLYBDENUM. Belous, O. A. Probl. Prochnosti; No. 6, 97-101(Jun 1971). (In Russian).

The mechanical properties and structure of specimens 1 × 6 × 40 mm from electron-beam remelted rods of Mo + 0.01 to 0.15% C and Mo + 0.03% C + 0.10 to 0.25% Zr were studied. Irrespective of C content up to 0.09%, the microhardness of cast Mo–C alloys remained fairly constant at ~210 kg/mm^2, but increases of C in that range were accompanied by progressive refinement of the grain size from 6 to 1.5 mm and a drop of critical cold brittleness temperature T_x. Further C additions reversed this trend. In Mo–C–Zr alloys, Zr additions markedly increased the microhardness up to 228 kg/mm^2 and U. T. S. by up to 20%, raised C solubility until at eutectic temperature a solid solution containing up to 3.5 wt-% ZrC could be reached. (Metals Abstr.)

15792 STOICHIOMETRY OF THE LOWER GERMANIDE OF VANADIUM. Borzhitskaya, M. K.; Zagryazhskii, V. L.; Surikov, V. I.; Shtol'ts, A. K. Tr. Ural. Politekh. Inst.; No. 186, 207-9(1970). (In Russian).

Microstructural and x-ray analytical methods were used to study alloys of the V–Ge system with Ge contents of 20.0, 23.5, 24.0, 24.3, 24.5, and 25.0 at. %, i.e., in the V_3Ge region. All samples were annealed at 1000, 1370, and 1500°C and, as a result of this treatment, all the alloys were two-phase except for the 24 at. % Ge alloy which was almost single-phase. The homogeneous region of the compound V_3Ge was somewhat shifted from stoichiometric towards the lower Ge compounds and is a very narrow region of 0.2 to 0.3 at. %. V_3Ge has a cubic lattice of the Cr_3Si-type with the cell constant in the homogeneous region, varying between 4.7830 and 4.7835 Å. (Referativnyi Zh.)

15793 THERMODYNAMIC PROPERTIES OF LIQUID ALLOYS OF THE CADMIUM–BISMUTH–ANTIMONY SYSTEM. Morachevskii, A. G.; Gerasimenko, L. N.; Zhuravlev, V. A. Tr. Leningrad. Politekh. Inst.; No. 304, 17-22(1970). (In Russian).

The emf method was used to determine the activity of Cd and the partial thermodynamic properties of Cd in liquid alloys of the Cd–Bi–Sb system in the temperature range 630 to 750°C. (Referativnyi Zh.)

15794 NEW METALS AND ALLOYS FOR NUCLEAR APPLICATIONS. Givord, J. P. (Laboratories de Recherches de Venthon, Albertville, France). Kerntech. Atomprax.; 13: No. 11, 498-504(Nov 1971).

Among the metals developed specifically for nuclear applications, Zr has reached a high level of industrial production and is beginning to find diversified uses. Three other metals, Hf (a by-product of Zr processing), Nb, and V, have had limited applications. The properties and uses of these four metals are reviewed and their possibilities for future development are examined. (auth)

15795 WETTING OF NIOBIUM WITH MOLTEN STEEL IN THE FORMATION OF NIOBIUM–STEEL WELDS. D'yachenko, V. V.; Sivov, E. N. Weld. Prod. (USSR) (Engl. Transl.); 18: No. 3, 8-10(Mar 1971).

Translated from Svar. Proizv.; No. 3, 5-7(1971).

The wettability of solid niobium by molten steel is determined mainly by the surface condition of the niobium, the solid and liquid phase temperatures, and the duration of solid-liquid contact. Satisfactory wettability of niobium can be improved by pickling in a mixture of 60% HNO_3 and 40% HF. The niobium must not be heated beyond 1700°C, because otherwise compound formation commences on the contact boundary. (auth)

15796 STRENGTH AND DUCTILITY OF HETEROPHASE CAST MOLYBDENUM ALLOWING FOR CRYSTALLOGRAPHIC

ORIENTATION. Statkevich, V. N.; Kuporev, A. L.; Malashenko, I. S.; Vashchilo, N. P. Probl. Prochnosti; No. 7, 110-14(Jul 1971). (In Russian).

The growth texture, disorientation of contiguous crystallites, and character of the substructure in cast Mo and Mo–0.06% C alloys obtained by electron-beam melting were studied in relation to the macroscopic strength and ductility of the corresponding materials. The strength and ductility of the complete samples were sensitive to the crystallographic orientations of the constituent phases. Carbide-phase particles reduced the overall ductility and also reduced the tendency towards brittle intercrystallite failure. (Metals Abstr.)

15797 INFLUENCE OF TECHNOLOGICAL FACTORS ON THE MECHANICAL PROPERTIES OF MOLYBDENUM ALLOYS AT LOW TEMPERATURES. Novikov, N. V.; Voitenko, A. F.; Voinitskii, A. G.; Ovsepyan, E. S.; Nekrasova, Z. P. Probl. Prochnosti; No. 12, 69-71(Dec 1970). (In Russian).

Results are given for elasticity, plasticity, and strength of Mo sheet alloy (containing Zr 0.1, Ti 0.15, and W 0.6%) in the temperature range –196 to 20°C. Young's modulus was determined by tensile testing in a special machine having an automatic temperature-regulated chamber. As the temperature decreased there occurred a change in the intensity of the increase in strength, depending on the structure. The determining factor controlling the properties is the preparation, the various specimens having been subjected to annealing, cooling, and rolling. (Metals Abstr.)

15798 INVESTIGATION OF THE MECHANICAL PROPERTIES OF HOT-PRESSED PSEUDO-ALLOYS OF TUNGSTEN AND COPPER. Karpinos, D. M. Probl. Prochnosti; No. 12, 64-8(Dec 1970). (In Russian).

The dependence of the mechanical properties of W–Cu pseudo-alloys on the density of the W base, the amount of low-melting component (Cu), and the time of the isothermal anneal at the pressing temperature was studied. The strength, plasticity, and impact strength increased with increasing density of the high melting base metal and with the time of holding at the temperature of the isothermal pressing, 1900 to 2200°C. The hardness and strength on compression depended, fundamentally, on the density of the base metal and the degree of filling of the pores by Cu. (Metals Abstr.)

15799 FLUCTUATIONS OF CONTACT RESISTANCE IN SLIDING CONTACT [WEAR]. Tsuchiya, K.; Tamai, T. Wear; 16: No. 5, 337-49(Nov 1970).

Relative reciprocating linear sliding motion was investigated in Sn, Zn, Al, Pb, Ag, Cu, Pt, Mo, and W specimens to examine the noise due to irregular fluctuations of contact resistance caused by adhesive wear. The size of wear particles showed good agreement with Rabinowicz's formula (ibid., 1964, 7, 9), which could be extended to cover surface roughness. The noise voltage characteristics caused by the fluctuations of the contact resistance were of two types. These noises were related to surface roughness and the size of wear particles formed during sliding motion, and to w/p, where W is the surface energy between the contact surfaces and P is the hardness of the metal. (Metals Abstr.)

15800 EFFECT OF RARE-EARTH ELEMENTS ON WELDABILITY OF MAGNESIUM–ZINC AND MAGNESIUM–ZINC–ZIRCONIUM ALLOYS. Antonov, E. G. Svar. Proizv.; No. 12, 6-8(Dec 1970). (In Russian).

The weldability and the mechanical properties of welded joints of Mg–Zn and Mg–Zn–Zr alloys containing small amounts (up to 0.6 wt %) of Nd and La were investigated. Zr increased the impact strength of the joints, whereas the addition of La and, particularly, Nd increased the brittleness of the joints. The resistance of the alloys to crack formation during welding was increased by alloying with La and Ce-mischmetal and by the use of a welding wire based on Mg and containing Zn 1.5, Zr 0.5, and Ce-mischmetal 3%. (Metals Abstr.)

15801 NEUTRON-DIFFRACTION STUDY OF SCANDIUM HYDRIDE. Miron, N. F.; Shcherbak, V. L.; Bykov, V. N.; Levdik, V. A. Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 4, 709-10(Jan-Feb 1972).

Translated from Kristallografiya; 16: No. 4, 822-3(Jul-Aug 1971).

Polycrystalline δ-phase $ScH_{1.88}$ samples were studied by neutron diffraction at room temperature. The reflections were indexed to a fcc lattice with a = 4.76 Å. The best fit was obtained using a model with the metal atoms arranged about the fcc lattice nodes and the H atoms occupying the tetrahedral voids (CaF_2-type structure). (D.L.C.)

15802 HIGH-PURITY, HIGH-STRENGTH CUPRO–NICKEL ALLOYS. Taubenblat, P. W.; Hsu, Y. T.; Opie, W. R. Technical Paper No. W71-12.3. Metals Park, Ohio; American Society for Metals (1971). 15p. $3.00.

Mechanical properties, electrical conductivity, creep, and fatigue data are given for Cu–30Ni–0.4Ti–0.3Be, Cu–5Ni–2.5Ti, and Cu–2Ni–1Ti. The alloys were prepared from high-purity OFHC Cu, alloyed with electrolytic Ni and high-purity Ti and Be metals. Total impurities are <0.1%. Because of their purity, these alloys are particularly adaptable for high vacuum applications. Because of their high strength at both room and elevated temperature, they are suitable for designing into structural parts. Because of their high conductivity, both the Cu–5Ni–2.5Ti and Cu–2Ni–1Ti (exhibiting 55–65% conductivity) are useful in electrical applications. With a simplified fabricating schedule, strengths of 100,000 lb/in^2 and over and conductivities of 50% and over are obtained with the alloys containing 90% min Cu. (Metals Abstr.)

15803 STUDY OF THE DEFECTS PRODUCED IN MAGNESIUM AND CADMIUM BY COLD-WORKING AT LOW TEMPERATURE. Simon, J. P. (CEN, Grenoble, France); Delaplace, J. J. Nucl. Mater.; 42: No. 2, 161-79(Feb 1972). (In French).

The production of defects and their recovery in cadmium and magnesium, cold-worked at liquid nitrogen temperature, were studied by means of simultaneous electrical resistivity and mechanical measurements. The electrical resistivity measured at 77°K varied linearly with strain up to 7% deformation for cadmium and 4% for magnesium. There were three main recovery stages in cadmium: the stage from 77 to 180°K was due to annealing of point defects, the stage from 180 to 240°K to dislocation rearrangement, and the stage over 240°K to recrystallization. From electrical resistivity measurements performed during the deformation of the samples, under load or unloaded, the resistivity of cadmium and magnesium changed during the removal of the load. This effect was due to the shortening of the dislocation segments which were bowed under stress and became straight when the specimen was unloaded. This model leads to reasonable orders of magnitude for the dislocation densities and network size. (auth)

15804 REASONS FOR DIFFUSENESS OF THE X-RAY DIFFRACTION LINES OF DEFORMED METALS. Vorob'ev, G. M.; Turba, N. N.; Gaivoronskaya, T. Z. Fiz. Metal. Metalloved.; 31: No. 5, 994-1003(May 1971). (In Russian).

The mechanism responsible for the diffuseness of the x-ray diffraction lines of worked metals is discussed. Thus the physical width of the diffraction lines in worked Ni and Nb is almost identical for radiations of widely differing wavelengths (for the same diffraction angle) as a result of the fact that the diffuseness arising from block size is small in comparison with that arising from microstresses in these metals. This does not apply in the case of carbonyl Fe. Errors arising from line diffuseness may be estimated and corrected by taking successive photographs with different radiations. (Metals Abstr.)

15805 EFFECT OF STRESSES ON URANIUM QUENCHING TEXTURE. Zelenskii, V. F.; Krasnorutskii, V. S. At. Energ. (USSR); 31: No. 5, 449-52(Nov 1971). (In Russian).

The effects of internal and external stresses on the texture formation in uranium for $\beta \rightarrow \alpha$ transition have been studied. The nature of a texture, formed in uranium, has been estimated to be dependent on a cooling rate from β-phase and be conditioned by obeying some known orientation relations. Therefore, the non-alternating stresses promote the forming of a varied texture in uranium as a function of the cooling rate. In any case, the texture definition is determined by the value of internal stresses produced in uranium in cooling process from the β-phase. (auth)

15806 MEASUREMENT OF THE VAPOR PRESSURE OVER SODIUM–CADMIUM ALLOYS BY THE ATOMIC-ABSORPTION METHOD. Muradova, O. N.; Muradov, V. G. (Ulyanovsk State Pedagogic Inst., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 45: No. 6, 872-3(Jun 1971).

Translated from Zh. Fiz. Khim.; 45: No. 6, 1544-5(Jun 1971).

The temperature variation of the partial pressure of sodium over sodium–cadmium alloys with 32.6, 16.5, and 12 at. % Na has been found by the method of atomic absorption using the 5890-Å sodium resonance line. (auth)

15807 PERFECTION OF THE STRUCTURE OF THE Au–In ALPHA PHASE: LATTICE PARAMETERS, SOLUBILITY LIMIT, EXPANSION COEFFICIENTS, DENSITIES, AND VOIDS. Straumanis, Martin E.; Patel, Vinayak K. (Univ. of Missouri, Rolla). Z. Metallk.; 63: No. 1, 33-7(Jan 1972).

Lattice parameters of Au–In solid solutions as well as the solubility limit of In in Au were redetermined. The densities were lower than the calculated ones. However, very few voids could be seen in the alloys quenched from the liquid state. Numerous voids appeared after heat treatment of the same samples.

Upon compression the voids could be closed and the density rose to the calculated value. The amount of vacancies could be estimated from the variation of the linear thermal expansion coefficient with the In content of the fractions. As there was a reasonable agreement with the concentration of vacancies calculated directly from the density decrease, it can be assumed that the formation of vacancies (and voids) is due to differential shrinkage of the various fractions crystallizing out of the liquid during solidification. (auth)

15808 FIELD-EMISSION ION-MICROSCOPE STUDY OF THE ADSORPTION PLASTIFICATION OF TUNGSTEN MICROCRYSTALS. Dranova, Zh. I.; Mikhailovskii, I. M.; Afanas'ev, V. I. (Kharkov Pedagogical Inst. Physical-Technical Inst., Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 179-81(Jul 1971). (In Russian).

The effect of adsorbed gases (O, N, etc.) on the strength and ductility of W microcrystals was studied in conjunction with a field-emission ion-microscope analysis of the surface-adsorption processes involved. Thus the adsorption of gases by the W surface led to the development of local slip processes, the direction and extent of which were fairly sensitive to the nature of the gas involved and the residual pressure of the latter in the experimental chamber. The changes in mechanical properties were most marked in the case of N. (Metals Abstr.)

15809 CHANGE IN THE ELASTIC MODULUS IN ALLOYS WITH A METASTABLE STRUCTURE. Grachev, S. V.; Grigor'eva, V. N. (Ural Polytechnic Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 32: No. 1, 156-62(Jul 1971). (In Russian).

Changes taking place in the elastic moduli of alloy steels (Cr–Ni, Cr–Si) and Cu–Be and Cu–Ti–Cr alloys with metastable structures on working and heat treatment were studied. Thus in general a metastable structure tended to create a lower elastic modulus than that corresponding to the stabilized state. The elastic modulus increased on heating the supersaturated solid solutions in question. These effects were partly attributed to changes taking place in the nature of the interatomic bonds on stabilization of the structure. (Metals Abstr.)

15810 EFFECT OF PLASTIC DEFORMATION ON THE BRITTLENESS OF TUNGSTEN. Shashkov, D. P. (Moscow Automobile-Highway Inst.). Fiz. Metal. Metalloved.; 32: No. 1, 131-8(Jul 1971). (In Russian).

The relation between the degree of plastic deformation and the brittleness of W samples produced by the powder-metallurgical techniques was studied. Thus there was a clear correlation between the change in brittleness temperature induced by plastic deformation and the segregation of impurities along the grain boundaries and in the regions immediately adjacent to these. This effect was particularly marked in the case of hydraulically extruded material; extrusion promoted the resorption of grain-boundary segregations and lowered the brittle transition temperature. (Metals Abstr.)

15811 BENDING TESTS ON BERYLLIUM SINGLE-CRYSTALS OF HIGH PURITY. Avotin, S. S.; Papirov, I. I.; Tikhinskii, L. A.; Kornienko, L. A.; Nikolaenko, A. A. (Physical-Technical Inst., Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 123-30(Jul 1971). (In Russian).

The mechanism underlying the deformation of high-purity Be crystals under conditions of pure bending was studied at 77 to 300°K. Thus the slipping of dislocations with a Burgers vector, c, and also dislocations of the c + a type played a major part in this process. Some of the single crystals tested underwent 90° bending down to 77°K; in others of different initial orientation the bending was not so great as this, while yet others exhibited an anomalous YS temperature dependence. The character of the transverse slip processes taking place in these crystals changed sharply with temperature. (Metals Abstr.)

15812 EFFECT OF ALLOYING WITH TITANIUM, ZIRCONIUM, OR NIOBIUM CARBIDES ON THE STRUCTURE AND PROPERTIES OF WORKED AND ANNEALED MOLYBDENUM ALLOYS. Afonina, T. M.; Burlakov, S. F.; Ivashchenko, R. K.; (and others) (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 114-22(Jul 1971). (In Russian).

The effect of TiC, ZrC, or NbC on the structure and on the mechanical properties of Mo and Mo alloys was studied. Thus, for example, the cellular structure of severely worked Mo alloys was stabilized by the incorporation of ZrC (0.8%). The incorporation of the carbide particles in highly dispersed form, together with the cellular structure of the material as a whole, increased the recrystallization temperature to 1500°C, so that even at this temperature, the high mechanical properties of the original cold-worked Mo continued to persist. In the presence of both TiC and ZrC a complex carbide was formed. (Metals Abstr.)

15813 MUTUAL DIFFUSION IN THE MOLYBDENUM/TUNGSTEN, TANTALUM/TUNGSTEN, AND NIOBIUM/TUNGSTEN SYSTEMS. Nechiporenko, E. P.; Krivoruchko, V. M.; Mitrofanov, A. S.; Kondratov, Yu. T. (Physical-Technical Inst., Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 89-95(Jul 1971). (In Russian).

Mutual diffusion effects taking place in the bimetallic Mo/W, Ta/W, and Nb/W systems were studied by x-ray microanalysis combined with a radioisotope tracer technique. The diffusion coefficients were determined at ~2000°C. Thus for samples consisting of equal mass of the constituents, the following values of pre-exponential factor and activation energy were obtained: Ta/W 3×10^{-3} cm²/sec and 58 kcal/mole, Mo/W 0.3 cm²/sec and 107 kcal/mole, Nb/W 7×10^{-4} cm²/sec and 65 kcal/mole. (Metals Abstr.)

15814 TEMPERATURE DEPENDENCE OF THE ELECTRIC TRANSPORT OF IMPURITY ATOMS IN MOLTEN METALS. Kuz'menko, P. P.; Khar'kov, E. I.; Korochkina, L. N. (Kiev State Univ.). Fiz. Metal. Metalloved.; 32: No. 1, 34-9(Jul 1971). (In Russian).

The temperature dependence of the electric-transport parameters of Ag, Sb, and Tl in molten Sn, Tl in molten Ga and Pb, and Ag in molten In was studied experimentally at 300 to 900°C, and the results were compared with existing theory. Thus the scattering cross sections were of the order of 10^{-16} cm² in each case, sometimes rising and sometimes falling with increasing temperature. The effective charges on the impurity atoms were fairly sensitive to temperature in both sign and magnitude, depending sharply on the nature of the impurity. Methods of improving agreement between theory and experiment are considered. (Metals Abstr.)

15815 CREEP-RUPTURE PROPERTIES OF CVD TUNGSTEN. Stephenson, R. L.; Federer, J. I. (Oak Ridge National Lab., Tenn.). pp 90-4 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The material used in a study of CVD-W was deposited as large sheets (approximately 2 by 14 in.). A fluorine content of 5 to 9 ppM was obtained by controlling the wall temperature of the deposition chamber. The creep properties of this material have been determined at 1400, 1650, and 2200°C. This material is compared with earlier CVD-W, arc melted W, and arc melted W-base alloys in terms of strength, ductility, and microstructure. The strength of this material is equivalent to earlier CVD materials and compares favorably with arc melted W-base materials at 1650°C and above. The rupture ductility of this material seems to be generally higher than that of earlier CVD-W. Results of tests of CVD-W specimens from different lots of material indicate that these properties are reproducible. (auth)

15816 BEHAVIOR OF CVD TUNGSTEN LAYERS ON MOLYBDENUM. Wahl, G.; Demny, J. (Brown, Boveri and Cie AG, Mannheim, Ger. Central Research Lab., Heidelberg). pp 95-100 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The emitter of the thermionic converter in the German in-core thermionic reactor (ITR) will be made of tungsten coated molybdenum. Therefore, the properties of the system CVD-tungsten-molybdenum were investigated. It was found that a molybdenum surface concentration of 5 at. % is tolerable in the thermionic converter. The tungsten layer structure and its dependence on the molybdenum surface treatment and on the deposition conditions were studied. To get good adhesion and small diffusion the molybdenum emitter should be polished, annealed afterwards and then coated with a coarse grained tungsten layer. The bulk diffusion of molybdenum in tungsten was investigated. To avoid a molybdenum surface concentration $C_{Mo} > 5$ at. % the necessary tungsten layer thickness is $d_1 = (65 \pm 15)$ μm for a life time of t = 10,000 h at an emitter temperature of T = 1900°K. This is only valid if the number of grain boundaries can be kept small. (auth)

15817 DIFFUSION PROBLEMS WITH W-COATED Mo EMITTERS. Butz, R.; Erley, W.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). pp 101-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Results of investigations of w layer diffusion in Mo electrodes are presented. Information is included on diffusion processes, diffusion effects on work function, chemical and grain boundary

diffusion, and methods of determining metallic layer thicknesses. (J.R.D.)

15818 DIFFUSION PROCESSES IN Mo–W THERMIONIC EMITTERS. Roux, F.; Ablitzer, D.; Vignes, A. (Ecole Nationale Superieure de la Metallugie et de l'Industries des Mines, Nancy). pp 109-18 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The diffusion phenomena in the molybdenum-tungsten system (volume interdiffusion, diffusion of molybdenum in tungsten grain boundaries, and pore formation) have been studied on massive diffusion couples and couples made of a piece of molybdenum as substrate and a layer of vapor deposited tungsten. Using massive couples, composition and temperature variations of the volume interdiffusion coefficient have been determined between 1800 and 2200°C. It was shown that at 1650°C the diffusion of molybdenum in the grain boundaries of a CVD tungsten layer deposited on a molybdenum substrate is the main diffusion process. At this temperature, the main process involved in the formation of a porous layer is the diffusion of molybdenum in the grain boundaries of the tungsten layer. Because voids can also be heterogenously nucleated on foreign particles present at the molybdenum surface before the tungsten deposition, some samples were electropolished before the tungsten deposition. No porosity was observed in these samples. (auth)

15819 EVAPORATION OF MOLYBDENUM IN VACUUM, IN O_2, AND IN H_2O ATMOSPHERES. Wahl, G.; Batzies, P. (Brown, Boveri und Cie AG, Heidelberg). pp 119-22 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The formation of volatile emitter metal oxides will enhance the emitter material evaporation in the converter of the German oxide fueled and hydride moderated incore thermionic reactor (ITR). Therefore the evaporation of molybdenum in oxygen atmosphere (5×10^{-6} torr > p_{O_2} > 5×10^{-7} torr; 2200°K > T > 1300°K) and in water vapor atmosphere (2×10^{-6} torr > p_{H_2O} > 5×10^{-7} torr; 2200°K > T > 1300°K) was investigated. The oxidation probability of a molybdenum in oxygen was found to be about 10% and in water vapor about 2%. The sublimation in vacuum was measured in the temperature range of 2400°K > T > 1900°K. (auth)

15820 PHYSICAL ADSORPTION AND SURFACE POTENTIAL MEASUREMENTS ON EVAPORATED METAL FILMS BEARING SODIUM DEPOSITS. Klemperer, Derek F.; Snaith, J. C. (Univ. of Bristol, Eng.). Ber. Bunsenges. Phys. Chem.; 75: No. 10, 1078-86(Oct 1971).

The interaction of sodium with steel surfaces is of interest in reactor technology. Methods were developed for measuring submonolayer concentrations of sodium deposited on evaporated metal films. These methods were used to examine the stability of sodium overlays. Surface sodium was estimated by continuous recording of the surface potential due to sodium using the diode method, by observing the fall in surface potential due to physically adsorbed xenon, and by observing the fall in monolayer value for physically adsorbed xenon which occurs at the same time. Heat data from the adsorption isotherms was also used. Sodium overlays on copper and on iron show no tendency to mix over the temperature range studied (77 to 423°K) but sodium appears to overrun the internal structure of films at an appreciable rate above 273°K. (auth)

15821 THRESHOLD ENERGY AND MECHANISMS OF ELECTRON IMPACT DESORPTION AND PHOTODESORPTION OF ADSORPTION LAYERS ON METALS. Menzel, D.; Kronauer, P.; Jelend, W. (Technische Univ., Munich. Technische Hochschule, Darmstadt, Ger.). Ber. Bunsenges. Phys. Chem.; 75: No. 10, 1074-8(Oct 1971). (In German).

Adsorbed particles on metal surfaces can be desorbed by electron impact and by irradiation with light. Since thermal effects can be excluded experimentally, it must be assumed that these processes proceed via electronically excited states of the adsorbate complex. The minimum energy necessary—the threshold energy—contains information as to the excited state involved. Measurements for some adsorbate systems show that desorption of neutrals and of ions by electron impact proceeds via different excited states. A comparison with the energy necessary for photodesorption shows that, at least in the case of CO on W, electron stimulated desorption and photodesorption of neutral CO should proceed via the same excited state. The possible nature of the primary excitation is discussed for this particular adsorption system. (auth)

15822 CAVITATION DAMAGE TO REFRACTORY METALS AND ALLOYS. Bogachev, I. N.; Veksler, Yu. G.; Karasyuk, Yu. A. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 6, 111-16 (1971). (In Russian).

The kinetics of cavitation damage suffered by cast and metalloceramic W, Mo, and Nb, and alloys based on these were studied in water at 17°C. All the samples were first subjected to recrystallization annealing. The cavitation resistance and the nature of the damage differed appreciably for the cast and metalloceramic types of any one metal. The extent of the difference depended on the nature of the metal and the pore distribution in the powder-metallurgical material. Reasons for these differences are presented and their practical importance is discussed. (Metals Abstr.)

15823 THERMODYNAMIC PROPERTIES OF LIQUID ALUMINUM–INDIUM SYSTEM. Lee, Yong K. J. Korean Inst. Metals; 8: No. 4, 205-11(Mar 1971). (In Korean).

Thermodynamic properties of the Al–In liquid system were studied in the range 700 to 950°C using a galvanic cell Al(liquid)|KCl–NaCl, $AlCl_3$ Al–In(liquid). The activities obtained showed large positive deviations from Raoult's law. The limits of the miscibility gap and location of the critical point were determined. Heats of mixing calculated from the data agreed well with independent calorimetric measurements of Wittig (Z. Metallkunde, 1963, 54, 81). Interaction energies and short-range-order parameters were also calculated. (Metals Abstr.)

15824 DESORPTION OF Na AND K FROM NIOBIUM. Stefanakos, E. K. (Univ. of Idaho, Moscow); Fadl, A. A.; Tinder, R. F. Surface Sci.; 28: No. 1, 221-8(Nov 1971).

The activation energies of desorption and the mean adsorption lifetimes τ_s of Na and K on niobium were measured in the temperature range of 850 to 950°K and pressures of 10^{-9} torr by a new technique. This involved the application of Na and K atoms to a Nb surface and the measurement of desorption peak temperatures as a function of linear temperature sweep rates in the range from 0.3 to 20°K/sec. The mean adsorption lifetimes so determined were $\tau_{s_{Na}} = 1.27 \times 10^{-13} \exp[(2.7 \times 0.2)/kT]$ sec, and $\tau_{s_K} = 4.6 \times 10^{-13} \exp[(2.5 + 0.2)/kT]$ sec. (auth)

15825 DETERMINATION OF BINDING ENERGY OF TRANSITION METAL ADATOMS ON CLEAN TUNGSTEN SURFACES. Nakamura, Shogo (Osaka Univ.). Oyo Butsuri; 40: No. 11, 1203-8(Nov 1971). (In Japanese).

The binding energy of individual atoms of 5-d transition metals on different planes of a tungsten single-crystal was measured by the low-temperature field desorption method using a field-ion microscope. Effective field correction of work functions, determined from the Fowler-Nordheim plots, led to agreement with the work functions obtained by the Kelvin method. Binding energies determined by the use of the compensated work functions, the effective desorption field, and the appropriate field desorption formulated to reasonable results. The increasing order of the binding energies of adatoms on different planes, namely, (110) < (100) < (112) < (111) agreed well with the energetics estimated from the Morse potential curve and the hard sphere model on crystal planes. (auth) (Japan)

15826 MEASUREMENT OF LATENT HEATS OF FUSION FOR REFRACTORY METALS. Lebedev, S. V.; Savvatimskii, A. I.; Smirnov, Yu. B. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 578-81(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 635-8(May-Jun 1971).

Latent heats of fusion and specific resistances in the solid and liquid states were measured by the electrical pulse heating method for wires of the following metals and alloys: Ni, steel, W, Ta, Mo, Pt, Mo–W, W–Re, Ni–W–Fe, Ni–Mo–Fe, Ni–Cr, and Ni–Mn. The results are in good agreement with data from static measurements, indicating the validity of the rapid heating method. (D.L.C.)

15827 LAWS GOVERNING THE KINETICS OF RECRYSTALLIZATION IN SINGLE-CRYSTAL METALS OF DIFFERENT DEGREES OF PURITY. Belyakova, M. N.; Zasimchuk, E. E. Fiz. Metal. Metalloved.; 31: No. 5, 982-93(May 1971). (In Russian).

The laws of recrystallization in metallic single crystals are discussed from the theoretical and experimental points of view. In contrast to polycrystalline material, in single crystals considerable obstacles arise in the formation of the first recrystallization centers, so that the recrystallization kinetics are characterized by a specific incubation period; the rate of formation of new centers is very low in the initial stages and only rises to its maximum steady value very slowly as the process develops. Impurities dissolved in the crystal retard the process, although the general shape of the kinetic curves remains the same. Examples are given for Mo. (44 references). (Metals Abstr.)

15828 EFFECTS OF PURITY AND HIGH TEMPERATURES ON THE THERMOELECTRIC CHARACTERISTICS OF MOLYBDENUM. Druzhinina, I. P.; Fraktovnikova, A. A.; Vladimirskaya, T. M. High Temp. (USSR) (Engl. Transl.); 9: No. 3, 603-4(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 654-6(May-Jun 1971).

The thermoelectric behavior of electrodes made from three different Mo materials (pure single crystals, TZM-2A alloy with Zr and Ti, and cermet) was determined at 0 to 1600°C relative to Pt. The purity did not affect the emf substantially, although it had an effect on reproducibility of the calibration curves. The stability of the emf under thermal cycling between 100 and 1750°C was studied, and the recrystallization temperature and structural changes were determined. The results indicated that the low recrystallization temperature (1000°C), unstable grain structure, and brittleness made the pure single-crystal material unsuitable for high-temperature measurements. (D.L.C.)

15829 COBALT INTERACTION WITH TANTALUM IN A STATE OF EQUILIBRIUM AND AFTER AN EXPLOSION. Bernard, V. B.; Dunaev, S. F.; Kuprina, V. V.; Burnasheva, V. V.; Ronami, G. N. Vestn. Mosk. Univ., Ser. II. Khim.; 12: No. 3, 365-6(May-Jun 1971). (In Russian).

The system Ta–Co was studied within all ranges of concentrations. The existence of intermetallic phases studied earlier was confirmed. A new intermetallic phase of composition $TaCo_5$ was observed. (auth)

15830 EFFECT OF CARBON ON THE DUCTILITY OF MOLYBDENUM. Morgunova, N. N.; Klypin, B. A.; Lastochkin, R. R. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 77, 63-7(1970). (In Russian).

The critical brittle temperature, T_{cr}, of rods of deformed and recrystallized Mo was studied in relation to C content (0.02 to 0.29%). Increase in C content had little effect on T_{cr} of recrystallized Mo but increased T_{cr} of deformed Mo. There is a relation between the change in T_{cr} and the microstructure. Thus, in deformed Mo containing various amounts of C, the carbides are of uniform size and distribution whereas in recrystallized Mo the carbides are reinforced with increasing C and form a network at the grain boundaries. (Referativnyi Zh.)

15831 SOLUBILITY OF BERYLLIUM IN THE CUBIC CARBIDES OF TITANIUM, VANADIUM, NIOBIUM, AND TANTALUM. Zainulin, Yu. G.; Alyamovskii, S. I.; Shveikin, G. P.; Shchetnikov, E. N.; Gel'd, P. V. Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial; No. 20, 68-70(1970). (In Russian).

The interaction of metallic Be with TiC, VC, NbC, and TaC in vacuum at 1500°C was studied from the point of view of mutual solubility. Thus all the carbides except TiC interacted with Be to form cubic solid solutions with the NaCl-type of lattice, these apparently being of the complex substitutional—interstitial type. In the case of VC the solid solutions were only formed with difficulty. This difficulty, together with the complete absence of solubility in TiC, was attributed to the fact that the Me–C and Me–Me interactions were stronger than in TaC and NbC. (Metals Abstr.)

15832 CALCULATIONS OF LIFETIME-LOSS BY THE RATE OF VARIATION IN TEMPERATURE FOR STEEL PIPES IN NUCLEAR AND CONVENTIONAL POWER PLANTS. Nowacki, H. G. Waerme; 77: No. 1, 1-12(1971). (In German).

In order to evaluate the lifetime-loss of a steel, basic relations of the rate of variation in temperature or the stresses caused by them, are established. Shape and material characteristics for hollow spheres and hollow cylinders are calculated. Taking the dimensions of different parts of a power-plant system as a basis, the load characteristics which serve as a standard for the operation-dependent load of the part are defined. Influencing factors such as pressure, rate of variation in temperature, and breakdown strength are calculated and demonstrated graphically. The results show that an increase in the pressure of the system significantly influences the lifetime-loss and that, exceeding the value of creep resistance resulting from the stresses caused by the rate of variation in temperature, the material damage is accelerated. The breakdown time is reduced by the increase in heating rate. Moreover, the deleterious effects of heating and cooling is the greater the earlier the steel is stressed by a rate of variation in temperature during operation time. (INIS)

15833 INTERCRYSTALLINE SEGREGATION IN BILLETS OF NICKEL-BASED CREEP-RESISTANT ALLOYS OBTAINED BY VACUUM ARC REMELTING. Maslenkov, S. B.; Burova, N. N.; Zemskaya, T. V. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 77, 49-55(1970). (In Russian).

X-ray microprobe analysis was used to determine segregated microheterogeneities in billets of the creep-resistant alloys EP 109 [C 0.1, Cr 8.5 to 10.5, Co 11 to 13, Al 5.2 to 5.4, W 6 to 7.5, Mo 6.5 to 8.0, B 0.02, Ce 0.01 to 0.02, and Fe 1.5%]; EI 929 [C 0.12, Cr 9 to 12, Co 12 to 16, Ti 1.4 to 2.0, Al 3.6 to 4.5, W 4.5 to 6.5, Mo 4 to 6, B 0.02, Fe 5, Ba 0.1, and V 0.2 to 0.8%]; EI 826 [Al 3, Ti 2, Cr 15, B 0.008, W 3, and Mo 3%]; and EI 598 [Fe 5, Al 1.5, Ti 2.5, B 0.008, C 0.08, V 2.5, W 6, and Mo 3%]. The alloys were prepared by vacuum arc remelting. The direction and intensity of segregation of the main components of the alloys were determined. Nb and Ti, which have a high chemical affinity for Ni, showed the strongest segregation. The alloying elements in order of increase in their tendency to segregation were Al, Co, Cr, W, Mo, Ti, and Nb. The segregation intensity of the alloying metals increased in the direction towards the axis of the billet and sharply increased on going from the columnar to the equiaxed crystallization zone. (Referativnyi Zh.)

15834 MECHANISM OF PLASTIC DEFORMATION IN NIOBIUM. Mil'man, Yu. V.; Trefilov, V. I.; Udovenko, A. A. Probl. Prochnosti; No. 12, 45-50(Dec 1970). (In Russian).

Some general comments are made on the properties of Nb considered from the point of view of its electronic structure and place in the periodic table. Mechanical-property tests and electron metallography were carried out to determine the effects of plastic deformation and annealing on the dislocation structure of polycrystalline Nb. The material used contained about 1% total impurities after electron-beam preparation, mainly Ta (0.5%). The differences in the mechanisms of plastic deformation of Nb compared with Mo and other Group VIA metals (bcc) lie in the decreased rigidity (directionality) of the interatomic bonds and in an increase in the value of the activation volume. (Metals Abstr.)

15835 EQUILIBRIUM CONDITIONS OF THE NICKEL–CHROMIUM–TITANIUM–ALUMINUM SYSTEM AT 850°C. Havalda, Andrej; Mauer, Jan; Ivan, Jozef; Sebo, Pavel. Kovove Mater.; 8: No. 6, 517-31(1970). (In Slovak).

The effects of Mo on the positions of phase boundaries in the 850°C isothermal section of the equilibrium diagram was studied. Alloys were prepared containing various Ti : Al ratios and 0 to 20 at.% Mo. Optical and electron microscopy and x-ray phase analysis were used for the investigation. The results are tabulated. In addition to the Ni_3Al- and Ni_3Ti-type phases in the Ni–Cr solid solution another phase δ(NiCr)Mo was present at Mo concentration of 10 at.%. Maximum Mo solubility in the basic solution is 10 at.%. It was not markedly influenced by the Ti : Al ratio. Considerable solubility of Mo in the γ′ phase occurred which was decreased by the presence of Ti in the alloy. (Metals Abstr.)

15836 ACTIVATED SINTERING OF TUNGSTEN. Kolar, D.; Jurca, S.; Trontelj, M. Mining Met. Quart. (Engl. Transl.); No. 1, 39-45(1970).

Translated from Rudarsko-Met. Zbornik; No. 1, 35-41(1970).

A review of activated sintering is presented. Experimental results, which indicate that Ni additions accelerate the sintering of W but strong activation is possible only with fine powders, are described. The Ni additions influence the recrystallization and grain growth of W. The relationship between Ni concentration and grain size in the sintered state shows a maximum which is thought to depend upon the initial grain size and to move to higher Ni concentrations for finer powders. No Ni phase could be detected at the majority of the grain boundaries by microprobe analysis. Ni phase was detected at only one of 34 boundaries analyzed; an unexpectedly low W concentration (1.3 to 2.8%) was found in this phase. (Metals Abstr.)

15837 RELATIONSHIPS BETWEEN THE LIFETIMES OF [TUNGSTEN CARBIDE–COBALT] HARD ALLOYS UNDER IMPACT AND HARMONICALLY REPEATED LOADING. Troshchenko, V. T.; Bakul, V. N.; Loshak, M. G. Probl. Prochnosti; No. 1, 41-4(Jan 1971). (In Russian).

Most hard alloys are used in situations where they undergo repeated impact loading in use. It is desirable to know the work capacity of such materials but this is difficult to determine experimentally. A method has been developed for determining the cyclic strength of such materials. Comparative fatigue tests were carried out on WC–Co alloys under impact and harmonic load-cycling conditions. The effects of Co content and cyclic stress level were studied. Defects in the structures had a greater effect on strength characteristics during fast deformation than under conditions of harmonic cycling. (Metals Abstr.)

15838 EQUILIBRIUM STATES IN IRON-RICH IRON–CHROMIUM–TUNGSTEN–CARBON ALLOYS AT A CARBON CONCENTRATION OF 0.20 PERCENT IN THE TEMPERATURE RANGE 700 TO 1150°C. Freiwillig, Rudolf; Dubsky, Jiri; Ciha, Karel; Cadek, Josef; Cochnar, Zdenek. Kovove Mater.; 8: No. 5, 419-32(1970). (In Czech).

Work is described relating to the conditions of stable phases in

this system at 700, 800, 1000, and 1150°C at concentrations of 0 to 18 Cr, 0 to 14 W, and 0.23% C. The samples were held at temperature for 5,000, 500, 300, and 50 hr, respectively. The results obtained by phase analysis, optical microscopy, electrolytic extraction, and x-ray analyses of anodic residues are presented in the form of plane graphs in which two of the component concentrations are varied while the other compositions and temperature are held constant. No new quaternary carbides were found. The carbides observed, M_3C, M_7C_3, $M_{23}C_6$, and M_6C, were derived from the carbides of the corresponding binary subsystems. A relatively extensive range of existence was found for the Laves phase Fe_2W. (Metals Abstr.)

Radiation Effects

Refer also to abstracts 16768, 16769, 16773, 16788, 16789, 17109, and 17110.

15839 (AI-AEC-13015) FUELS, MATERIALS, AND COOLANT CHEMISTRY PROGRAMS. Quarterly Technical Progress Report, July–September 1971. (Atomics International, Canoga Park, Calif.). 15 Nov 1971. 70p. Dep. NTIS.

Research and development progress is reported on FFTF component testing, component cleaning after Na exposure, modeling of Na frost phenomenon, modeling Na oxide deposition on reactor components, Na friction testing, reactor coolant cover gas analysis, radiation damage in reactor materials, and radioinduced He production in reactor materials. (J.R.D.)

15840 (ANCR-1016, pp 91-157) MATERIALS. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

ALUMINUM—corrosion by water under ATR and ETR conditions
ALUMINUM A & S—Al–U, radiation effects on blistering and swelling of plate-type fuels of, at high burnups
BORON NITRIDES—compatibility with Zircaloy-4 at high temperatures
CRYSTALS—vibrations of, calculation using valence symmetry coordinates
—force constants of, calculation using changes in ground state electron energy
EXPERIMENTAL BREEDER REACTOR-II—fuels for, microprobe inspection of
INCOLOY—radiation effects on fatigue at high temperatures, fast neutron
MOLECULES—force constants of, calculation using changes in ground state electron energy
NEUTRONS, FAST—effects on fatigue of Incoloy 800 and Type 316 stainless steel at high temperatures
NITRIC ACID—HNO_3–$UO_2(NO_3)_2$, corrosive effects on Type 304 stainless steel at 185°F
NOZZLES—caps for waste calciner, microprobe inspection of
POTASSIUM A & S—K–Na, compatibility of liquid, with stainless steel at high temperatures
POWER BURST FACILITY—fuels for, calculation of creep stress on grains in
REACTOR FUEL ELEMENTS—corrosion of simulated Zircaloy-clad, by water at 2100 to 2400°F, mechanisms of
SODIUM A & S—K–Na, compatibility of liquid, with stainless steel at high temperatures
STAINLESS STEEL—compatibility of Types 304, 316, and 318, with flowing potassium–sodium alloys at high temperatures
—corrosion of Type 304, by nitric acid solutions of uranyl nitrate at 185°F
—radiation effects on fatigue of Types 304 and 316 at high temperatures, fast neutron
URANIUM A & S—Al–U, radiation effects on blistering and swelling of plate-type fuels of, at high burnups
URANYL NITRATES—HNO_3–$UO_2(NO_3)_2$, corrosive effects on Type 304 stainless steel at 185°F
WATER—corrosive effects on aluminum at ATR and ETR temperatures
—corrosive effects on Zircaloy fuel cladding at high temperatures
ZIRCALOY-3—corrosion by water at high temperatures, mechanisms of
ZIRCALOY-4—compatibility with boron nitride at high temperatures (P.C.H.)

15841 (CONF-680614–, pp 71-80) METALLOGRAPHY OF HELIUM-EMBRITTLED INCOLOY 800. Pard, A. G.; Rhodes, C. G.; Garr, K. R.; Kramer, D. (Atomics International, Canoga Park, Calif.). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

Helium was injected into small tensile samples of Incoloy 800 by bombardment to the level of 4×10^{-5} atom fraction. Subsequent tensile testing between 500 and 800°C revealed a loss in ductility, as measured by elongation at failure, with increasing temperature. Reduced ductility was always accompanied by partial or total intergranular failure, as determined by light and electron metallography techniques. Intergranular cracks originated as small voids adjacent to grain-boundary carbide particles, presumably through grain-boundary sliding. The presence of helium bubbles at grain-boundary carbide particles reduced the time required to nucleate a void through grain-boundary sliding, thus causing premature failure. This embrittlement mechanism is the same as that described for Types 304 and 316 stainless steel. (auth)

15842 (COO-1367-44) EFFECT OF ELECTRON IRRADIATION ON THE STRENGTH OF IRON SINGLE CRYSTALS. Sato, Akikazu (Northwestern Univ., Evanston, Ill.). Jun 1972. 160p. Dep. NTIS.

Thesis.

The effects of electron irradiation on the plastic deformation of ultrapure iron have been investigated in the temperature range from 4.2 to 373°K. Special care has been taken to minimize the uncertainty due to impurities, dislocations, and sub-boundaries; namely, every single crystalline specimen grown from the ultrapure iron supplied by the Battelle Memorial Institute was purified in the ZrH_2 system. These specimens exhibited appreciable ductility down to 4.2°K. In addition to these ultrapure specimens, less pure single crystal specimens grown from the Ferrovac-E iron were used to study the effects of the residual impurities. The total electron dose ranged from 5×10^{16} to 2×10^{18} e/cm^2 with the incident electron energy of 1.3 MeV. Both the electron irradiation and tensile tests were carried out in a liquid helium cryostat. The tensile testing as well as the electron irradiation were always carried out at or below 60°K. The results showed that the electron irradiation caused a softening effect on the flow stress at 60°K up to the total electron dose of 2×10^{18} e/cm^2. However, this softening was not observed at 4.2°K. In the microyield region, irradiation hardening was observed at 60°K. This hardening effect was significantly enhanced at the lower temperature, 4.2°K. Post-irradiation aging at higher temperature (150°K) enhanced the hardening effect at 60°K. Besides these low-temperature experiments, the effects of irradiation and aging on the macroscopic deformation were also studied at temperatures from 60 to 312°K. A temperature insensitive hardening was observed in the temperature range 233 ~ 312°K. Upon testing at 60°K, the specimen showed twinning and ductile fracture. In order to examine the possible effects of interstitials a calculation was carried out. The dislocation motion through a combined stress field of Peierls potential and misfit strain centers was examined. The effect of the presence of the strain centers appeared to reduce the double kink nucleation energy. By increasing the strength of the misfit strain centers, it was found further that there is a second kind of energy required for the motion of the kinks. These two types of energies were then carefully examined so that the total dislocation motion can be simulated. The results of this calculation explained the overall experimental observations found in the experiment. Every aforementioned item in the experimental results can be consistently explained on the ground of the present model of the dislocation motion. Aside from the detailed discussion it should be emphasized that the introduction of point obstacles into pure iron causes softening effects, and that this fact clarifies the role of the inherent lattice resistance in the plastic deformation of pure iron. (auth)

15843 (HEDL-TME-71-139) COMPILATION OF DATA AND EMPIRICAL REPRESENTATIONS OF IRRADIATION-INDUCED SWELLING OF SOLUTION-TREATED TYPES 304 AND 316 STAINLESS STEEL. Bates, J. F.; Straalsund, J. L. (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 24p. Dep. NTIS.

Extensive data for irradiation-induced swelling in annealed AISI Type 304 and 316 stainless steel have been compiled. An empirical equation is provided which describes swelling as a function of irradiation temperature and fluence (E > 0.1 MeV). (auth)

15844 (KFK-1438) DEFECT PRODUCTION RATES AND DISPLACEMENT CROSS SECTION IN METALS AND ALLOYS ON IRRADIATION IN REACTORS AND ACCELERATORS. Ehrlich, K.; Kaletta, D.; Schneider, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Jul 1971. 21p. (In German). Dep. NTIS (U. S. Sales Only).

Defect production rates due to nuclear interaction between bombarding and target atom have been calculated for the case of neutron with the hard-sphere-model, for the case of charged particles (α, $^{12}C^{++}$, $^{58}Ni^{+}$) with a modified inverse power potential. Results are reported for bombarding energies E_0 between 25 eV and 100 MeV for nickel and stabilized 4988 stainless steel. With the simplified assumption that only simple Frenkel defects (vacancy-interstitial pairs) are produced it follows that the EBR II and DFR reactors have almost twice the damage rate as the SNR. In the case of ion bombardment the damage rate near the end of the range is several orders of magnitude larger than in the neutron case, consequently much shorter irradiation times are required. In a closing discussion the problems of spikes vs. Frenkel defect production are discussed in terms of the mean free displacement path and of the mean transferred energy. (auth)

15845 PHASE TRANSFORMATIONS IN THIN FILMS OF IRON AND NICKEL ON BOMBARDMENT WITH HELIUM IONS. Bykov, V. N.; Zdorovtseva, G. G.; Troyan, V. A.; Khaimovich, V. S. (Moscow Engineering Physics Inst.). Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 4, 699-701(Jan-Feb 1972).

Translated from Kristallografiya; 16: No. 4, 810-12(Jul-Aug 1971).

Deposited films of Ni, Fe, Cu, and Ag were examined by the electron-diffraction method after they had been bombarded by singly charged He ions having an energy of 35 keV (the total radiation dose was 2×10^{17} ions/cm^2). The structure of Ni and Fe films after ionic bombardment consists of a hexagonal lattice with an almost ideal axial ratio. Subsequent annealing causes a reverse transformation of Ni and Fe to the cubic lattice. Cu and Ag films irradiated under the same conditions underwent no change in structure. (auth)

15846 DILATION OF ELECTRON IRRADIATED GERMANIUM. Gotwals, John Kulp. Lafayette, Ind.; Purdue Univ. (1971). 150p. University Microfilms Order No. 72-1868.

Thesis.

The effects of 4.5-MeV electron irradiation on the length and resistance of single crystal n-type and high-purity germanium were investigated. Bombardment and measurements were performed at both liquid helium and liquid nitrogen temperatures. Changes in length were obtained by a capacitor technique which measured the changes in spacing of a system of parallel-plate capacitors produced by changes in length of the sample. Changes in length on the order of 0.1 Å were detectable. Contrary to measurements made by others, the length change of electron irradiated high purity germanium was found to be consistent with the results of length change experiments on n- and p-type doped germanium. Irradiation of high purity germanium produced a specific fractional length dilation of $\Delta L/(L\phi) = 2.7 \times 10^{-24}$ cm^2 at 80°K and 3.9×10^{-24} cm^2 at 15°K. On the assumption that defects were produced at the same rate as are permanent defects in degenerate material, values of the fractional atomic volume change per defect of 0.12 and 0.18 were obtained at 80 and 15°K respectively. Irradiation of a degenerate n-type germanium sample at 15°K gave $\Delta L/(L\phi) = -6.1 \times 10^{-24}$ cm^2. This value is, within experimental error, equal to the value found by others for degenerate n-type material. Lightly doped n-type germanium was irradiated at 15°K. The overall specific length change at large fluences was found to be the same as the value obtained for pure material at 15°K. This sample exhibited measurable length change shuttling effects after a fluence of 3×10^{15}/cm^2 had been reached. After any given irradiation, the sample expanded by an amount δL when the sample was irradiated with a short burst of electrons and contracted by the same amount when the sample was raised briefly to a temperature of 20°K and then recooled to 4.2°K. These length changes were produced by the electronic volume effect associated with shuttling electrons between trapping levels and defect levels. Thus, by using the shuttling properties of the sample it was possible to separate at least part of the electronic volume effect from the pure atomic effect of the defects. For fluences larger than $\approx 3 \times 10^{16}$/cm^2, δL became essentially constant at $\delta L/L \approx 10^{-6}$. To account for the possibility that not all the available electrons were being shuttled, the effects of the known facts and various assumptions about growth rates, thermal electron mobilities, relative electron capture cross sections, and relative positions of the defect levels on the number of electrons being shuttled were analyzed. It is concluded that one or more defect states with large cross sections must lie above one or more defect states with small cross sections and that appreciable electron mobility must exist in defect levels at 20°K. Radiation annealing of the 65°K defect is necessary to account for the relatively slow saturation of the δL curve with increasing fluence. Two treatments of radiation annealing were made, and for each it was found that several arrangements of the defect levels could give agreement with the observed δL curve when suitable assumptions were made regarding the other factors enumerated. Distinction between the possibilities will require further information about these factors. The relatively small changes in sample resistance which were observed when electrons were shuttled could not be explained using a bulk conduction model. An interpretation based on the assumption of a surface conduction process was much more satisfactory. This brings into question the bulk conduction interpretations which have been made of other experiments. (Diss. Abstr. Int., B)

15847 NEW METHOD FOR EVALUATING THE BRITTLE-FRACTURE SUSCEPTIBILITY OF MATERIALS [:RESULTS FOR NEUTRON-IRRADIATED STEEL]. Dusek, Frantisek; Sykora, Milan; Mazanec, Karel. Kovove Mater.; 9: No. 1, 38-46(1971). (In Czech).

A method described previously (ibid., 1967, 5,541 and 1969, 7,183) was used to study relative absorption capacity (η) and dynamic YP(σ_{kd}) of A2 steel (C 0.16, Mn 1.08, Si 2.26, Ni 0.9, Cr 0.5, Mo 0.35, and Cr 0.1%) after neutron irradiation in a reactor channel with a dose of 1.35×10^{19} n/cm^2. The relationships between η and temperature (–50 to +100°C) and σ_{kd} and deformation rate were determined by this method. The value of η decreased by 30% and σ_{kd} increased by 30 to 40% at deformation rates of 10^{-3} to 10^{4}/sec after this neutron dose. (Metals Abstr.)

15848 EFFECT OF BETA RADIATION ON THE VAPORIZATION OF SILVER–INDIUM ALLOY. Spitsyn, Vikt. I.; Sklyarenko, I. Ya.; Priselkov, Yu. A.; Zimakov, I. E. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 199: No. 2, 394-7 (11 Jul 1971). (In Russian).

The vaporization of pure Ag and Ag–5% In alloy was studied before and after exposure to ^{90}Sr-emitted β-particles. Vaporization of the alloy in the absence of radiation had an unsteady character, and the data showed scatter. The beta irradiated sample exhibited a steady vaporization of the components. The method employed was that of variation in total resistance of an effusion chamber to a molecular stream of the vapor. (K.S.W.)

Other Materials

Refer also to abstracts 14928, 14972, 14974, 15396, 15631, 15749, and 16759.

15849 (CONF-680614–, pp 113-22) METALLOGRAPHIC PROCEDURE FOR AN EXPLOSIVE MATERIAL: RDX DISPERSED IN TNT. McGrath, F. E. (Battelle Columbus Labs., Ohio). Dec 1971.

From twenty-second AEC metallography group meeting; San Diego, Calif. (19 Jun 1968).

A procedure for the metallographic preparation of an explosive material, RDX dispersed in TNT, is described. The procedure involves conventional polishing techniques using diamond abrasive as a polishing medium. Etching to reveal the microstructure of the material is described and photomacrographs and photomicrographs are presented to illustrate the results of the metallographic procedure. Precautionary measures for the safe handling of the explosive material are enumerated and discussed. (auth)

15850 (INIS-mf-169) ARGON DIFFUSION IN NEUTRON-IRRADIATED POTASSIUM CHLORIDE AND ITS REACTIONS WITH LATTICE DEFECTS. Mueller, M. (Technische Universitaet, Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaft). 1970. 79p. (In German). INIS.

Thesis.

The nuclear reaction K(n,p)Ar in reactor-irradiated KCl leads to a loading with radioactive argon gas. Factors affecting the diffusion kinetics of the argon at elevated temperatures are the deformation of the crystals, the neutron dose, and the neutron spectrum. The kinetic behavior is interpreted using the trap diffusion model of Norgett and Lidiard, Gaus, and Hurst. According to this model, the argon diffuses over interstitials in the KCl lattice. An additional reaction with lattice defects results in a decrease of the diffusion coefficient. Diffusion values measured in the high-temperature region are interpreted as argon interactions with cation vacancies. The binding energy of an argon bound to a cation vacancy is determined to be ΔH = 1.26 eV. In the low-temperature region, the interaction with another kind of defects seems to be preferred, whose concentration is unaffected by dose and temperature. So the dose dependence of the diffusion coefficient observed in this temperature region can only be explained by a radiation-caused change in the binding situation of argon with the defect. (ΔH = 1.88 eV at a neutron dose of 5.16×10^{14} cm^{-2}; ΔH = 1.42 eV at a neutron dose of 3.09×10^{17} cm^{-2}.) (orig./Be) (INIS)

15851 PHYSICAL AND CHEMICAL TESTS INDICATING POST-IRRADIATION CHANGES IN PACKAGING MATERIALS IN THE FOODSTUFF INDUSTRY. Holeckova, L.; Kyselova, B.; Lanzer, O. (Research Inst. of Food-Stuff Industry, Prague). Prum. Potravin; 22: No. 3, 73-80(1971). (In Czech).

Twenty-four kinds of packaging materials of domestic and foreign make used in the foodstuff industry were exposed to doses of up to 5 Mrad. Changes induced by irradiation were examined by physical and chemical methods. The changes were found to depend on the type of material, production technology, and the radiation dose. A 20 % deviation from the properties of nonirradiated samples was chosen as the limiting criterion of quality. The results are presented in graphs and tables. (NSA of Czech)

15852 WURTZITE–ZINCBLENDE PHASE TRANSFORMATION IN IRRADIATED ZINC SELENIDE. Williams, P. M.; Yoffe, A. D. (Cambridge Univ., Eng.). Phil. Mag.; 25: No. 1, 247-55 (Jan 1972).

The damage produced in wurtzite platelets of zinc selenide by heavy-ion bombardment was observed by means of transmission electron microscopy. The annealing behavior of such damage was noted, and it was shown that a phase transformation to the zinc-blende modification occurs under certain conditions. The origin of the partial dislocations responsible for this transformation was identified and their cooperative motion was observed. (auth)

15853 CONTAINER MADE OF CONCRETE AND METHOD FOR ITS PRODUCTION. (to Polensky and Zoellner). British Patent 1,257,863. 22 Dec 1971. Priority date 20 Jan 1968, Germany.

Methods of constructing concrete containment structures for reactors or for storage of explosives are described. The walls of the structure comprise several layers of prestressed concrete arranged in spaced relationship incorporating deformable filler material in the spaces. The container-wall constructed in this manner is capable of absorbing high impact loads. (J.R.D.)

15854 USE OF PLASTICS AND ELASTOMERS IN NUCLEAR RADIATION. Parkinson, W. W.; Sisman, O. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Des.; 17: No. 2, 247-80(1971).

Common plastics and elastomers are described in general with emphasis on the relation between chemical structure and engineering properties and applications. The interaction of radiation with organic materials is described very briefly and radiation-induced crosslinking and scission, which lead to changes in physical properties, are discussed. The radiation-induced changes in specific plastics are described. Polyethylene, which can be regarded as a prototype for the more complex polymers, develops crosslinks at the rate of 1 to 1.5 for every 100 eV of radiation energy absorbed. The hardness and elastic modulus increase and the flexibility and ductility decrease until the usefulness at doses above 10^9 rads is uncertain for some applications. Polystyrene demonstrates stabilization by the aromatic ring, undergoing change at a lower rate than polyethylene. Polymethyl methacrylate exemplifies polymers containing the quaternary carbon atom, which leads to chain scission and rapid loss of strength properties. Polymers with a high content of strongly electronegative elements also degrade rapidly. Elastomers are discussed separately because elasticity and flexibility are affected very rapidly by the crosslinking and scission produced by radiation. Applications of plastics and elastomers in reactor systems or their vicinity are discussed. The properties which are important to the application are presented along with the radiation-induced changes in these properties. (auth)

NUCLEAR MATERIALS MANAGEMENT

Accountability and Safeguards

15855 (GULF-RT-A-10914) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, July 1, 1971–September 30, 1971. Bramblett, R. L.; Costello, D. G.; Ginaven, R. O.; Naliboff, Y. D.; Rundquist, D. E.; Trimble, G. D. (Gulf Radiation Technology, San Diego, Calif.). 17 Dec 1971. Contract AT(04-3)-167. 45p. Dep. NTIS.

The research and development performed during the period July 1, 1971 to September 30, 1971, on techniques and applications of nondestructive measurements of nuclear materials is described. This program is sponsored by the Office of Safeguards of the United States Atomic Energy Commission. The assay results of the field operation at the National Reactor Testing Station (NRTS) for the Mobile Assay System (GAMAS) are discussed in detail. Design details of the partially fabricated sample scanner for GAMAS are also given. (auth)

15856 (SZS-12/71 (pp 1-9)) RADIATION PROTECTION IN THE GERMAN DEMOCRATIC REPUBLIC. Scheel, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jul 1971. (In German and English).

The activities of the National Center for Radiation Protection of the GDR are briefly outlined considering regulatory activities, licensing, radiation protection supervision of man and his environment, radioactive wastes, training, and research. (auth)

Disposal and Storage

15857 (KFK-1455) SURVEY OF THE OPERATIONAL FACILITIES AND DEVELOPMENT INSTALLATIONS FOR HANDLING AND REMOVAL OF RADIOACTIVE WASTE IN THE KARLSRUHE NUCLEAR RESEARCH CENTER. Baehr, W.; Diefenbacher, W.; Hild, W.; Krause, H. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug 1971. 48p. (In German). Dep. NTIS (U. S. Sales Only).

The facilities and installations available at the Karlsruhe Nuclear Research Center for treatment, transport, and intermediate storage of solid and liquid radioactive wastes and for decontamination of equipment are described. The operating experience gained over the past ten years is highlighted. The most important methods either newly developed or improved in the laboratories, such as removal of polyphosphates from liquid effluents, decomposition of complexing agents through ozonization, saponification of tributyl phosphate, decomposition of nitric acid without residues, decontamination of surfaces, incorporating aqueous residues in bitumen, vitrification of fission product residues, and melting of fission products into ceramic masses by thermite reactions are discussed. The most important process engineering activities performed in the solidification of high-level fission products and the nuclear and process engineering development work carried out on the storage of radioactive wastes at the Asse salt mine are outlined. (auth)

15858 SUCCESSFUL WELDING OF RADIOISOTOPE STORAGE CAPSULES. Wormeli, John C. (Atlantic Richfield Hanford Co., Richland, Wash.). Weld. J. (N. Y.); 50: No. 12, 849-58(Dec 1971).

Development of materials and techniques for remote encapsulation of radioisotopes is described. Compatibility tests were conducted on materials for encapsulation of SrF_2 and CsCl compounds. Hastelloy C276 was chosen for SrF_2 capsules while 316 stainless steel was chosen for CsCl capsules. Information is included on weld processes, ultrasonic testing and capsule evaluation. (J.R.D.)

Handling Equipment and Procedures

Refer also to abstract 16896.

15859 DISPLACEMENT AND BALANCING DEVICE FOR A MASTER-SLAVE MANIPULATOR. Germond, Jean-Claude; Guilbaud, Jean-Pierre; Vertut, Jean (to Commissariat a l'-Energie Atomique). French Patent 2,061,940. 1 Jun 1971. Filed 3 Oct 1969. (In French).

This equipment vertically displaces the entire slave assembly in a cell, while retaining it in the plane containing the master assembly and the transversing tube, the master assembly situated at the exterior of the cell remaining fixed. Each assembly of the displacement device consists of a segment pivoting about an articulation axis on a transversal segment, which connects the assemblies. Each cord of the flexible part of the transmission passes between two pullies rigidly attached to one of the segments and over a moving pully. All the moving pullies corresponding to the assembly of flexible transmission parts are carried by the same moving part, which can be displaced in the same direction as the segment. The slave assembly balancing mechanism utilizes a counterbalance weight supported by articulated rods. (France)

Transportation

15860 (ORNL-TM-3531) ANALYSIS OF THE SRP 25-TON TARGET TUBE CASK. Shappert, L. B.; Evans, J. H. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 122p. Dep. NTIS.

The Savannah River 25T Target Tube Cask is used to ship transuranium materials in either one of two internal configurations. Calculations which indicate that the cask is in compliance with the requirements of AEC Manual Chapter 0529 are given. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

15861 (CEA-N-1473) BEAM-LOADING COMPENSATION IN A PROTON LINAC CAVITY: STUDY AND DESIGN OF AN RF LEVEL REGULATOR. Sitbon, Victor (Commissariat a l'Energie Atomique, Saclay (France), Centre d'Etudes Nucleaires). Sep 1971. 125p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The Van de Graaff injector of the Saturne Synchrotron was replaced in 1969 by a 20 MeV proton linac. During normal operation a current in excess of 20 mA is required. A feedback system was studied in relation to the beam loading compensation necessitated by the 600 μsec pulse duration. The real r-f field build up in the cavity was studied theoretically; a dynamic measurement of the input impedance of the driving loop was then undertaken. A feedback circuit was constructed. The design, performance, and preliminary studies made on this circuit, which is currently used with Saturne, are described. (France)

15862 (LBL-373) ELECTRON RINGS FOR HEAVY-ION ACCELERATION. Peterson, Jack M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1971. Contract W-7405-eng-48. 4p. (CONF-711021-10). Dep. NTIS.

From International conference on multiply-charged heavy ion sources and accelerating systems; Gatlinburg, Tenn. (25 Oct 1971).

The characteristics, operation, and problems associated with a heavy-ion electron-ring accelerator are discussed. Also, the status of electron-ring accelerator research at the Lawrence Berkeley Laboratories is outlined. (W.H.K.)

15863 (OPTIK-1/71) ELECTROMAGNETIC RADIATION OF THE PTB 140-MeV ELECTRON SYNCHROTRON. Kaase, Heinrich (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Oct 1971. 21p. (In German). Dep. NTIS (U. S. Sales Only).

The electromagnetic radiation magnitudes of a synchrotron are given analytically in the usual form for radiation measurement and were determined numerically with the machine data of the 140 MeV synchrotron of the PTB. The results of these calculations are given graphically and discussed. Whether this electron accelerator is usable as a radiation standard in the wavelength region between 200 and 800 nm was studied. The problems to be expected in such use are considered. (tr-auth)

15864 300-GeV ACCELERATOR PROJECT. Amaldi, Edoardo (Univ., Rome, INFN, Rome). Com. Naz. Energ. Nucl., Notiz.; 17: No. 10, 33-45(Oct 1971). (In Italian).

The project history and the main specifications of CERN's 300-GeV PS, the construction of which was approved by the Council on February 19, 1971, are discussed. (auth)

15865 STATIC MEASUREMENT OF BEAM PROFILES. Kliwer, J. K.; Sharma, D. D.; Dardis, T. A. (Univ. of Nevada, Reno). Nucl. Instrum. Methods; 97: No. 3, 611-12(1971).

A method for measuring an effective beam profile is presented which requires no relative motion between the beam and the probe during the course of a measurement. The beam profile is measured by observing the intensity of the K_α x-rays from a target which consists of a series of elements evaporated into concentric rings on a thin backing. (W.H.K.)

Auxiliaries and Components

15866 (LUNP-7012) STABILIZATION OF MAGNETIC FIELDS WITH HELP OF NUCLEAR SPIN RESONANCE. Naucler, Lars (Lund Univ. (Sweden). Dept. of Physics). Oct 1970. 19p. (In Swedish). Dep. NTIS (U. S. Sales Only).

Two methods using nuclear spin resonance are described for control of the magnetic field in the deflecting magnet of a Van de Graaff accelerator. (Sweden)

15867 (RPP/A-87) SUPERCONDUCTING PULSED MAGNETS FOR A 1000-GeV SYNCHROTRON. Thomas, D. B. (Rutherford High Energy Lab., Chilton (England)). Sep 1971. 17p. (CONF-710908-7). Dep. NTIS (U. S. Sales Only).

From eighth international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

The experimental work in progress at the Rutherford Laboratory on superconducting pulsed magnets for synchrotron application is reported. The present state-of-the-art is described, in particular the recent preliminary testing of the first superconducting dipole of representative aperture. Future plans include the construction and testing of a fully engineered version of this magnet, representative in all respects except one (length) of that required for a 1000 GeV conversion of the European 300 GeV machine. This magnet is scheduled for completion in 1973. (auth)

15868 (SC-RR-710655) CONTOUR MAPPING OF THE CURRENT DISTRIBUTION FROM THE PULSED REBA ELECTRON BEAM MACHINE VERSUS TIME WITH AN ARRAY OF FARADAY CUPS. Kelly, John G.; Schuch, Robert L. (Sandia Labs., Albuquerque, N. Mex.). Jun 1971. 124p. Dep. NTIS.

An array of 13 small Faraday cups has been used to measure the time development of the spatial distribution of a 45 kA, 3.5 MeV, 100 ns pulsed electron beam in a 10-inch (25.4 cm) diameter drift tube at air pressures of 22.5 and 3.9 Torr and 520, 320, 160, and 90 microns. The contour maps constructed from these data display the formation and the decay of the pinch structure. Discussions are given of the Faraday cup array design, of the experiment on the REBA accelerator, and of the data reduction techniques. (auth)

15869 COMPUTER CONTROLLED SHADOW MEASUREMENTS IN A CYCLOTRON. Schreuder, H. W.; Schneider, E. (Technological Univ., Delft, Netherlands). Nucl. Instrum. Methods; 97: No. 3, 615-16(1971).

A method is described for computer control of beam shadow measurements in a cyclotron. A measurement is reduced to measuring probe positions for probe currents of 95%, 50%, and 5% of total beam current. A series of 30 shadow measurements is performed in three minutes. (auth)

15870 TRIPLE PHASE RECTIFIER. Pierson, Alexandre (to Commissariat a l'Energie Atomique). French Patent 2,067,744. 26 Jul 1971. Filed 14 Nov 1969. (In French).

A triple phase rectifying device is described. It is characterized by the fact that each phase is connected across the diagonal of a full-wave rectifying bridge possessing 4 diodes. The three bridges, each corresponding to a particular phase, are connected in series. The device can be used to feed the electrodes of charged particle accelerators. (France)

15871 DEVICE PRODUCING A VERY HIGH d-c POTENTIAL. Fremiot, Charles (to Commissariat a l'Energie Atomique). French Patent 2,068,094. 26 Jul 1971. Filed 27 Nov 1969. (In French).

A device was developed, which can produce a very high d-c potential relative to earth. The principal uses envisaged include operating particle accelerators. The device consists of a large number of cells provided with rectifiers; the outputs of these cells are connected in series. Each cell is fed with electrical energy from a microwave receiving antenna coupled to an emitting antenna fed by a waveguide connected to a microwave generator. The emission antennas, the generator and the waveguide are maintained at earth potential. (France)

15872 DETERMINATION OF MULTIPOLE ADMIXTURES IN QUADRUPOLE FIELDS BY INCREMENTAL FIELD MEASUREMENT BY MEANS OF A HALL PROBE. Jung, V. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 98: No. 1, 157-63(1972).

The field strength in an ideal quadrupole field is $B(r) = g \cdot r$, where g is the gradient and r the distance from the neutral axis. It is possible to check the constancy of the field value at the distance r from the axis by means of a Hall probe, if the probe, which is led on a circle around the neutral axis, follows the given direction of the field also by rotation around its own axis. The two movements are coupled in a program-controlled measuring machine in which an adjusting device aligns the sensitive axis of the probe with its axis of rotation. The respective admixtures of higher multipole orders can be analyzed from the fluctuation of the field value along the circle traversed. The study was undertaken for design optimization of quadrupole magnets for synchrotrons with separated function optics. (auth)

15873 SIMPLE CODING SYSTEM FOR MULTIWIRE PROPORTIONAL COUNTERS. Bonazzola, G. C. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin); Bressani, T.; Chiavassa, E.; (and others). Nucl. Instrum. Methods; 98: No. 2, 273-7(1972).

A simple realization of the coding system permitting to reduce from N to $2\sqrt{N}$ the number of electronic channels necessary to read a multiwire proportional counter with N wires is described. The results of a test on a π^- beam are reported. (auth)

15874 INEXPENSIVE PROPORTIONAL WIRE CHAMBER PROFILE MONITOR FOR SECONDARY BEAM LINES. Bellinghausen, P. R.; Lachance, T. J. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 98: No. 2, 269-72(1972).

An electronic system used in association with a proportional wire counter has been used successfully to display beam profiles in secondary beam lines of the Zero Gradient Synchrotron. The electronic package is inexpensive and simplifies the tuning procedure for beam lines. (auth)

Ion Sources, Injection, and Extraction

15875 (CONF-711012-13) LONG-LIFE, HEAT-PIPE-HEATED, CHARGE-TRANSFER CELL. Bacal, M.; Olier, N. (Paris Univ., Orsay (France). Institut de Physique Nucleaire); Reichelt, W. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 2p. Dep. NTIS (U. S. Sales Only).

From Symposium on ion sources and formation of ion beams; Upton, N. Y. (19 Oct 1971).

A lithium charge exchange chamber for the production of negative helium ions for tandem accelerators is described. An annular cesium-filled heat pipe is used to maintain the desired high temperature. Results from the first-run operation are given. (W.H.K.)

15876 CONSTANT-TEMPERATURE LIQUID NITROGEN COOLED BOAT FOR ARC DISCHARGE ION SOURCES. Sitter, C. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 98: No. 1, 169-71(1972).

A description is given of a liquid nitrogen cooled boat that can be used to contain charge materials for the ion source of an electromagnetic isotope separator. It is designed to make efficient use of milligram quantities of charge materials that have low vaporization temperatures or are easily decomposed by excessive heat. It has been used with an arc discharge ion source and although the source dissipates several hundred watts, the boat is maintained accurately at any preset temperature in the range 0 to 400°C and operates for hours without attention. (auth)

15877 CROSSED FIELD ANALYZER FOR USE IN A 6 MV VAN DE GRAAFF ACCELERATOR. Tykesson, P. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods; 98: No. 1, 185-6(1972).

A crossed field analyzer has been designed and tested as a terminal analyzer in a 6 MV Van de Graaff accelerator. The analyzer has considerably decreased the tube loading and made it possible to accelerate doubly charged helium. A $^3He^{++}$ beam of 1 μA has been obtained after the analyzing magnet at a total accelerated beam of 10 μA as well as an analyzed proton beam of 140 μA at a total accelerated beam of 150 μA. (auth)

15878 USE OF CARBON FOILS FOR HEAVY-ION STRIPPERS. Yntema, J. L. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 98: No. 2, 379-80(1972).

The lifetime of carbon foils when bombarded by high-density heavy-ion beams is increased if the foil is kept at a high temperature. (auth)

Ion Optics and Field Calculations

15879 (KFK-EXT-3/71-6) LONGITUDINAL BEAM-LOADING EFFECTS IN A SUPERCONDUCTING PROTON LINEAR ACCELERATOR. Heller, Ferdinand (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jul 1971. 142p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Longitudinal beam-loading effects due to a proton beam of several mA in superconducting cavities are investigated analytically and numerically under stationary acceleration conditions. A unified perturbation treatment is found, which is consistent in the range of pertaining parameters. For the accelerating mode a new type of instability is described which may occur at high beam-loading and seems to be known from circular accelerators only. Further, excitation of unwanted nonresonant modes is discussed under acceleration conditions yielding more exact predictions for both regenerative and cumulative type excitation than the usual small-signal treatment. Stability conditions are shown to depend mainly on two parameters, the number of phase oscillations per tank and an effective beam loading ratio. From them it is concluded that longitudinal instabilities of any type should not occur for the present design of a superconducting proton linear accelerator or, at least, can be avoided without major difficulties. (auth)

15880 BETATRON AMPLITUDE GROWTH UPON TRAVERSING RESONANCES DURING THE COMPRESSION CYCLE OF AN ELECTRON RING ACCELERATOR. Laslett, L. J.; Perkins, W. A. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 97: No. 3, 523-38(1971).

In an electron ring accelerator electrons are often injected into a magnetic field with index $n = -(r/B_z)(dB_z/dr)$ of about 0.5. For extraction and axial acceleration of the ring, n must approach zero and several betatron resonances are crossed. Following particles on a computer through simulated fields (which approximate measured experimental fields) has elucidated which resonances are important and which magnetic field perturbations cause large growth for a particular geometry and coil-energizing sequence. Analytical formulas for resonance growth also have been derived and checked against the computer calculations. These equations indicate the important driving terms of the field and are convenient for estimating the expected growth on traversing a resonance. Resonances at n = 0.5, 0.36, 0.25, and 0.20 have been investigated. (auth)

15881 ROUNDING CORNERS ON POLES OF POLYGONAL PROFILE. Lee-Whiting, G. E. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods; 97: No. 3, 433-41(1971).

Approximate calculations of the effects of rounding by circular arcs the corners on flat-ended poles in a quadrupole magnet are described. Curves are plotted to show how the maximum pole-surface flux density and two field-expansion coefficients vary with effective rounding radius. The same method is applied to the study of a compound pole whose profile consists of a flat tip joined smoothly by circular arcs to straight lines inclined to the axes of symmetry. A singular solution of Laplace's equation which applies to a finite discontinuity of curvature on a continuous-slope boundary is identified. (auth)

15882 ACCURATE CALCULATION OF PROPERTIES OF THE TWO-TUBE ELECTROSTATIC LENS. II. FIRST-ORDER FOCAL PROPERTIES AND P-Q CURVES. Natali, S. (Univ., Bari, Italy); Di Chio, D.; Uva, E.; Kuyatt, C. Rev. Sci. Instrum.; 43: No. 1, 80-3(Jan 1972).

Using digital methods, electric fields and paraxial electron trajectories in the two-tube electrostatic lens have been calculated, and the first-order (Gaussian) focal properties accurate to at least 0.1% were obtained for voltage ratios from 1.5 to 50. The results are presented in the form of P-Q (object-image position) curves for maximum ease of use. (auth)

15883 ACCURATE CALCULATION OF PROPERTIES OF THE TWO-TUBE ELECTROSTATIC LENS. III. ABERRATION COEFFICIENTS. Kuyatt, C. E. (National Bureau of Standards, Washington, D. C.); Natali, S.; Di Chio, D. Rev. Sci. Instrum.; 43: No. 1, 84-7(Jan 1972).

Using numerical methods, electric fields and meridional electron trajectories have been calculated for the two-tube electrostatic lens with sufficient precision to determine values for all the third-order and several of the fifth-order aberration coefficients for meridional trajectories. The aberration coefficients are expressed in a form which is intrinsic to the lens and do not depend on a particular object and aperture position. Results were obtained for voltage ratios of 2, 5, 10, 20, and 40. (auth)

15884 DESIGN PARAMETERS FOR THE CYLINDRICAL MIRROR ENERGY ANALYZER. Risley, John S. (Univ. of Washington, Seattle). Rev. Sci. Instrum.; 43: No. 1, 95-103 (Jan 1972).

Design parameters are presented for various geometrical arrangements of the cylindrical mirror electron energy analyzer. The theory and operation of this high quality instrument are discussed and compared with an experimental device. Similar properties of a parallel plate analyzer with second order focusing are reviewed. (auth)

15885 TWO-DIRECTIONAL FOCUSING WITH DEFLECTING MAGNETS. Ciuti, P.; De Guarrini, F. (Univ., Trieste, Italy). Nucl. Instrum. Methods; 98: No. 2, 361-4(1972).

The effect of the extended fringing field on the focusing properties of the deflecting magnets is studied. A rapid procedure which permits to determine the focusing characteristical parameters has been developed. The method and the computer program allowing to solve the problem and to trace the diagrams useful in the practical cases are also reported. The name of the program is "BEXMAP." (auth)

15886 STUDIES OF MULTIBAND STRUCTURES BY MEANS OF CIRCUITS WITH LOCALIZED ELEMENTS. Tran, D. T. (Thom-

son-CSF, Orsay, France). Nucl. Instrum. Methods; 98: No. 2, 285-99(1972). (In French).

In modern linear accelerators and in magnetrons or traveling wave tubes, to reduce the beam loading effect and to reconcile the structure efficiency and its sensitiveness to mechanical errors, sophisticated structures are often designed by associating several elementary circuits. Then, several pass-bands could interfere. Dispersion properties of such multiband structures are studied. Using matrix calculus and applying the positive real properties of impedance, behaviour of series-coupled and parallel-coupled structures are derived. A series-coupled structure is defined as a succession of resonant elements without coupling between non-adjacent ones and more generally as a structure such that its period could be simulated by a four-port circuit. In the parallel coupling case two or more propagating lines are associated together. Allowed and forbidden forms of dispersion curves can be predicted according to the coupling configuration and the type of the elementary systems. Forms of dispersion curves of biperiodic, triperiodic structure, deflecting structure, interdigital structure and so on, are explained. Experimental investigation is presented on a few modern structures to illustrate the theoretical work. A new structure, derived from the organ pipe structure, and proposed recently by the author as a variable energy accelerating structure is discussed. An interdigital structure used as low energy accelerating structure as well as magnetron circuit is also considered. Finally, coupling between TE and TM modes is studied with connection to the "compensation" problem in Alvarez structures. (auth)

15887 ANALYTIC METHOD FOR CLOSED ORBIT CORRECTION IN HIGH ENERGY SYNCHROTRONS. Maidment, J. R.; Planner, C. W. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 98: No. 2, 279-84(1972).

An analytic method is presented, which allows minimization of the closed orbit at a number of specified points around the orbit by means of special correcting dipoles or by transverse displacement of the lattice quadrupoles. The method may be applied to any number of sensor/correcting element combinations and is therefore particularly suitable for synchrotrons greater than 100 GeV. The magnitude of computation and computer storage required for the application of the method is comparatively small. (auth)

Storage Rings

15888 (INFN-71/65) ELECTRON AND POSITRON STORAGE RINGS: PRESENT SITUATION AND FUTURE PROSPECTS. Amman, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Sep 1971. 16p. (LNF-71/65; CONF-710908-9). Dep. NTIS (U. S. Sales Only).

From eighth international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

Ten years have passed since the first electrons have been stored in a colliding beam ring; e^+e^- rings have produced high energy physics results for about five years and a new generation of ultra-high luminosity rings is being built. The progress in the field and the experimental observations on the beam behavior in storage rings, gathered in many laboratories all over the world, are outlined. The possible improvements in the performances are briefly discussed. (42 references). (auth)

15889 (LNF-71/60) REMARKS ON TWO BEAM BEHAVIOUR OF THE 1.5-GeV ELECTRON POSITRON STORAGE RING ADONE. Amman, F.; Bassetti, M.; Cattoni, A.; (and others) (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 15 Sep 1971. 8p. (CONF-710908-8). Dep. NTIS (U. S. Sales Only).

From eighth international conference on high energy accelerators; Geneva, Switzerland (20 Sep 1971).

The status of the machine is described and an analysis of the behavior with two circulating beams is discussed. (auth)

15890 DEVICE FOR MEASURING THE LUMINOSITY OF THE COLLISION RING AT ORSAY. Augustin, J. E.; Buon, J.; Haissinski, J.; (and others) (Ecole Normale Superieure, Orsay, France). Nucl. Instrum. Methods; 97: No. 3, 497-506 (1971). (In French).

A precise monitoring device for the luminosity is used at the Orsay e^+e^- storage ring (ACO). Two lead-scintillator sandwich counters detect the photons emitted at small angles in the double bremsstrahlung reaction $e^+e^- \rightarrow e^+e^-\gamma\gamma$. The detection thresholds of these two counters are accurately determined by a tagging method of the bremsstrahlung photons. The ratio from the coincidence rate $\dot{N}$ between the pulses of the two sandwich counters to the double bremsstrahlung cross section σ gives the luminosity L, L = $\dot{N}/\sigma$. The whole uncertainty on L is quite small: $\Delta L/L = \pm 1.5\%$ (statistical) $\pm$ 2.5% (systematic). (auth)

Experimental Facilities

Refer also to abstract 14725.

15891 (BNL-tr-465) FORMING IN A VACUUM A JET TARGET FROM CONDENSED HYDROGEN. Bartenev, V. D.; Valevich, A. I.; Pilipenko, Yu. K.; Smelyanskii, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR-P13-6058. 20p. Dep. NTIS.

The development of a gaseous jet target located at the internal beam of an accelerator for studying p + p and p + d scattering is described. Topics include collimation of the jet, maintenance of the temperature regime, vacuum, and jet display and parameters. (W.H.K.)

15892 (UR-875-365) PRODUCTION OF A HIGH DENSITY HYDROGEN GAS JET. Gross, D. A.; Melissinos, A. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 2 Dec 1971. Contract AT(30-1)-875. 52p. Dep. NTIS.

The production of pulsed supersonic jets of H_2 and He with densities of the order of 10^{-7} gm/cm^3, for durations of 25-200 msecs, is described. The densities were measured with a constant temperature anemometer that was constantly self-calibrated in a static pressure mode by the determination of accommodation coefficients of the gases used. Such supersonic jets are to be used as internal targets in high energy experiments. (auth)

15893 PRODUCTION OF HYDROGEN SULFIDE FROM ^{34}S FOR NUCLEAR REACTIONS. Luedecke, H.; Schroeter, H. (Max-Planck-Intitut fuer Kernphysik, Heidelberg). Nucl. Instrum. Methods; 97: No. 3, 613-14(1971).

Pure gaseous hydrogen sulfide was obtained using the reaction of atomic hydrogen, which was produced in an electrical glow discharge with 50 mg solid ^{34}S. (auth)

15894 BUTANOL POLARIZED DEUTERON TARGET. II. POLARIZATION AT 50 kOe. Borghini, M.; Masaike, A.; Scheffler, K.; Udo, F. (CERN, Geneva). Nucl. Instrum. Methods; 97: No. 3, 577-9(1971).

Deuteron polarization up to 26% was obtained in 98% perdeuterated 1-butanol and heavy water mixtures, doped with porphyrexide, at 1 K and 50 kOe. The polarization of the 2% unsubstituted protons in the same samples reached 86%. (auth)

15895 SELF-SUPPORTING COBALT TARGET PREPARATION. Zhukova, O. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 70-2(Mar-Apr 1971). (In Russian).

A method is described for preparing a self-supporting Co target for nuclear investigations. A Co film is electrolytically deposited on an Al support; the Al is later dissolved away in KOH. Details are given for both techniques. (1 figure) (tr-auth)

15896 CYLINDRICAL MIRROR ANALYZER WITH SURFACE ENTRANCE AND EXIT SLOTS. II. RELATIVISTIC PART. Sar-El, H. Z. (Soreq Nuclear Research Centre, Yavne, Israel). Rev. Sci. Instrum.; 43: No. 2, 259-63(Feb 1972).

The relativistic treatment of the cylindrical mirror analyzer with surface entrance and exit slots is presented. Theoretically, its operation was found to be entirely unrestricted by the relativistic effect even for ultrarelativistic particles. A comparison of this device with other double focusing magnetic and electrostatic analyzers is presented. (auth)

15897 PICOSECOND BEAM MONITOR. Beck, G.; Schutt, D. W. (Univ. of Notre Dame, Ind.). Rev. Sci. Instrum.; 43: No. 2, 341-2(Feb 1972).

A coaxial transmission line beam monitor with a risetime of approximately 18 psec is described. This monitor was used to examine the fine structure of the electron beam from an L-band linear accelerator. (auth)

15898 POLARIZED PROTON TARGET FOR LOW ENERGY SCATTERING EXPERIMENTS DOWN TO LESS THAN 10 MeV. Kuiper, H.; Diekamp, J.; Frank, K.; (and others) (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 98: No. 1, 151-5(1972).

A polarized proton target for low energy experiments has been constructed and used at the Erlangen tandem accelerator. The free protons of the waters of hydration in a $3 \times 3 \times 0.05$ mm^3 LMN crystal are polarized by the solid effect at a temperature of 1.4 K in a magnetic field to 18.5 kG using 71 GHz microwaves from a klystron. 60% proton polarization is obtained. Constructional and operational details are discussed. (auth)

15899 POLARIZED ^{3}He TARGET CONSTRUCTION. Hardy, D. M.; Baker, S. D.; Boykin, W. R. (Rice Univ., Houston, Tex.). Nucl. Instrum. Methods; 98: No. 1, 141-5(1972).

A description of a type of polarized ^{3}He target, suitable for low energy nuclear scattering experiments, is described with emphasis on construction and procedural details. (auth)

15900 GENERAL PURPOSE CHARGED PARTICLE SCATTERING CHAMBER ON THE UNIVERSITY OF BIRMINGHAM A. V. F. CYCLOTRON. England, J. B. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 98: No. 2, 237-54(1972).

A scattering chamber of unconventional design for use in elastic scattering and reaction studies with the unpolarized and polarized beams of the University of Birmingham A.V.F. cyclotron is described. The design specification and details of the construction are given together with brief descriptions of some of the types of experiment which have been made with this chamber and which illustrate its precision and versatility. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

15901 PROCEEDINGS OF THE FOURTEENTH GENERAL ASSEMBLY, BRIGHTON 1970. International Astronomical Union Conference, Brighton, England, August 18–27, 1970. De Jager, C.; Jappel, A. (ed.). Transactions of the International Astronomical Union, Volume XIVB. Dordrecht, Netherlands; D. Reidel Publishing Company (1971). 385p. f 50.-. (In French and English). (CONF-700853).

This volume contains the report of the executive committee for the triennial period 1967 to 1969, the reports of the Inaugural ceremony and the General Assembly at Brighton, the reports of the Commission Meetings, and the Astronomer's Handbook. (W.D.M.)

15902 HIGHLIGHTS OF ASTRONOMY. VOLUME 2. XIVth General Assembly of the IAU, Brighton, England, August 18–27, 1970. De Jager, Cornelis (ed.). Dordrecht, Netherlands; D. Reidel Publishing Company (1971). 802p. f 140.-. (CONF-700852-(Vol.2)).

This volume contains the texts of the invited discourses given at the 14th General Assembly held in Brighton, August 1970. It contains further the papers and discussion remarks presented at the six joint discussions, as well as the invited papers given at the special session on the Moon. The paper given at the joint meeting of Commissions 24, 27, 30, 33, and 37 on RR Lyrae stars is also included. (W.D.M.)

Cosmic Radiation

Refer also to abstracts 15951, 16109, and 16207.

15903 (AECL–4055) COSMIC RAY NM-64 NEUTRON MONITOR DATA, CHACALTAYA, BOLIVIA. IV. JANUARY–DECEMBER 1970. Anda, R.; Mejia, G. R.; Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs. Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica). Sep 1971. 54p. (In English and Spanish). Dep. NTIS (U. S. Sales Only). AECL $1.50.

Uncorrected and barometer corrected results from the cosmic-ray station at Chacaltaya, Bolivia, from January through December 1970 are given in tabular form. Normalized graphs of the neutron monitor are also given. (auth)

15904 CHANGES OF INTENSITY OF PRIMARY COSMIC RAYS DURING THE HALF-CYCLE OF SOLAR ACTIVITY. Nikolaev, Yu. M. Kosm. Luchi; No. 11, 29-32(1969). (In Russian).

A model is suggested for the quasi-stationary diffusion of primary cosmic rays in the supposition of the stationary solar wind with spherical symmetry. On the basis of experimental results and application of elementary physical conceptions, an expression was obtained for the diffusion coefficient as the function of solar activity (numbers of groups of solar spots). Expressions for the time variations and the radius gradient of the primary cosmic-ray intensity are given. The time variations correlate with the results of rocket measurements for the half-cycle, while the calculated value of the radius gradient at the Earth's orbit differs (by 7 to 8 times) from the experimental value. This indicates the necessity to make allowance for the lagging and prolonged modulation region. (Meteorol. Geoastrophys. Abstr.)

15905 ANGULAR AZIMUTHAL DISTRIBUTIONS OF HIGH-ENERGY COSMIC RAYS IN LUNAR SILICATE MINERALS. Van Loon, L. G. (Univ. of New South Wales, Kensington). Lett. Nuovo Cim.; 2: No. 23, 1179-82(4 Dec 1971).

An examination of pieces of a lunar rock with a major axis of 15 cm and a minor axis of a cm has shown the presence of an abundance of cosmic-ray tracks. The sharply defined directions and their occurrence in multiple parallel beams open up the possibility of measuring distributions of primary cosmic rays in lunar materials by means of the interactions they cause. The experimental procedure, track distribution, interesting events, and cosmic-ray spectrum are described. (W.D.M.)

Stars

Refer also to abstracts 16059 and 16713.

15906 PROFILES OF EMISSION LINES IN Be STARS. Huang, Su-shu (Northwestern Univ., Evanston, Ill.). Astrophys. J.; 171: No. 3, 549-64(1 Feb 1972).

The broadening functions resulting from a gaseous ring in circular motion around a star according to Kepler's law were studied. When the distribution in the gaseous ring has a circular symmetry in the equatorial plane, the broadening profile is related to the surface density distribution along the radius by an integral equation which can be transformed into the Abel integral equation and solved analytically. Profiles corresponding to gaseous rings with a uniform density distribution but different widths are used to illustrate the general properties of the profile broadened by the gaseous ring in circular motion. When the distribution in the gaseous ring lacks circular symmetry, the profile becomes not only asymmetric with respect to the center of the line but also time dependent. The variation of profiles has a time scale measured in terms of hours or days depending upon the size of the ring, and may explain what has been observed by Hutchings and others in some Be stars. It is also shown that such a variation is damped by the differential rate of revolution of emitting atoms in accordance with Kepler's law of motion. The time scale of damping is determined by the radii of both the outer and inner boundary circles of the gaseous ring. It is expected that for reasonable sizes the damping will obliterate, observationally, the time variation in terms of years. That this kind of variation has often been observed only shows the existence of a continual process, such as frequent ejections of matter from the central star, that creates the uneven distribution along the circular arc from time to time. The emission profile was also studied for cases in which the circular motion does not follow Kepler's law. It is shown that a change in the law of motion which gives the velocity as a function of radius is equivalent to a proper modification of the density distribution in the Keplerian case, provided that the velocity varies monotonically with the radius. Consequently, the integral equation can likewise be transformed to the Abel form. Finally, some unresolved problems concerning the formation of gaseous rings are briefly discussed. (auth)

15907 MARINER 9 ULTRAVIOLET SPECTROMETER EXPERIMENT: STELLAR OBSERVATIONS. Lillie, Charles F. (Univ. of Colorado, Boulder); Bohlin, Ralph C.; Molnar, Michael R.; Barth, Charles A.; Lane, Arthur L. Science; 175: No.4019, 321-2(21 Jan 1972).

Photoelectric spectra were obtained for a number of early-type stars in the 1100- to 2000-angstrom region with the Mariner 9 ultraviolet spectrometer. The resonance lines of H I, Si IV, and C IV were easily identified, as were features due to C II, C III, Si III, Fe II, and N IV. The absolute energy distribution derived from the data was about 20 % below those of OAO-2 in the 1200- to 2000-angstrom region. (auth)

15908 EVOLUTION OF GROWING STELLAR CORES UP TO CARBON IGNITION: FROM WHENCE THE PULSARS? Barkat, Zalman; Wheeler, J. Craig; Buchler, Jean-Robert (California Inst. of Tech., Pasadena). Astrophys. J.; 171: No. 3, 651-62 (1 Feb 1972).

It has been argued that stars in the main-sequence mass range $4 \lesssim M/M_{\odot} \lesssim 10$ will explode and leave a collapsed remnant, as implied by empirical evidence, if the central density at carbon ignition (ρ_{ign}) is greater than some limit (ρ_{crit}). Herein the factors influencing ρ_{ign} are examined in detail and a comparison between ρ_{ign} and ρ_{crit} and their respective uncertainties are given. The proposed scenario for pulsar formation is within the realm of possibility, but current uncertainties forestall any firm conclusion. (auth)

15909 NEW INFORMATION ON THE RATE OF THE CARBON-BURNING REACTION. Mazarakis, Michael; Stephens, William (Univ. of Pennsylvania, Philadelphia). Astrophys. J.; 171: No. 3, L97-9(1 Feb 1972).

New measurements of the cross section for the $^{12}C + {}^{12}C$ carbon-burning nuclear reaction are reported, extending down to a center of mass energy of 2.45 MeV, equivalent to a thermal temperature of 10^9 °K. A rise in the nuclear factor at the lowest energy may be interpreted as an optical giant resonance or a collection of compound nuclear resonances on the one hand or "absorption under the barrier" according to a theory by Michaud and Vogt. Reaction rates are tabulated for various burning temperatures. (auth)

15910 LIGHT VARIATIONS IN MAGNETIC STARS. Trasco, John D. (Univ. of Virginia, Charlottesville). Astrophys. J.; 171: No. 3, 569-82(1 Feb 1972).

A magnetic field exerting nonzero stresses is assumed to be present in a stellar atmosphere. The pressure and density gra-

dients between the magnetic and the nonmagnetic regions needed to maintain equilibrium are calculated. It is found that the equilibrium configuration likely to be reached in the magnetic A and B stars is one in which the temperature in the magnetic region is higher than that in the surrounding nonmagnetic regions. The effects of line absorption on the light flux are also considered, and it is found that the main result of an increase in the line absorption should be a small increase in the flux in the V band for the cooler magnetic stars. These combined effects are found to agree in general with the observations. The main discrepancies occur for stars with two magnetic spots of nearly equal strength. Some possible causes for these discrepancies are discussed. (auth)

15911 ADVANCED EVOLUTION OF POPULATION II STARS. III. SOME UNCERTAINTIES IN HORIZONTAL-BRANCH MODELS. Demarque, Pierre; Mengel, John G. (Yale Univ. Observatory, New Haven). Astrophys. J.; 171: No. 3, 583-91(1 Feb 1972).

Evolution from the zero-age horizontal branch was investigated for stars with the chemical composition parameters (X,Z) = (0.75, 10^{-3}) and masses 0.50, 0.56, and 0.60 $M_{\odot}$. For the 0.60 $M_{\odot}$ models, the effects of semiconvection and of the choice of interpolation between opacity tables were studied. It was found that increasing the free–free opacities in the region enriched in carbon and oxygen affects the evolution markedly, yielding longer blue loops and a horizontal branch thicker in luminosity. Semiconvection, which has the effect of increasing the size of the convective core and of forming an extensive region of varying chemical composition, also leads to longer blueward loops and longer times spent on the horizontal branch as opposed to the asymptotic branch. Astronomical implications are briefly discussed. (auth)

15912 MASSES OF CEPHEID VARIABLES. Fricke, K. (Inst. of Theoretical Astronomy, Cambridge, Eng.); Stobie, R. S.; Strittmatter, P. A. Astrophys. J.; 171: No. 3, 593-604(1 Feb 1972).

Results of stellar pulsation and evolution computations were applied to a large sample of Cepheid variables in order to derive independent estimates of their mass. That the masses derived from evolution theory were significantly greater than those obtained from pulsation theory confirmed previous results. It is also shown that a significant discrepancy exists between independent pulsation mass determinations for Cepheids with a secondary maximum in their light curves. Attempts to remove this discrepancy by alterations in semi-empirical data or prescribed composition are shown to introduce further observational difficulties with, for example, the high-temperature boundary of the instability strip The quantitative results of nonlinear pulsation theory thus appear to be in conflict with observation. Extreme caution is urged in using the results of pulsation or evolution computations in deriving values of parameters (mass, luminosity, etc.) associated with stars or clusters. (auth)

15913 ULTRAVIOLET SPECTROPHOTOMETRY OF ARCTURUS FROM A ROCKET. Kondo, Yoji (Manned Spacecraft Center, Houston, Tex.). Astrophys. J.; 171: No. 3, 605-8(1 Feb 1972).

Spectrophotometric observations of Arcturus were obtained at the resolution of about 7 Å in the wavelength region 2700 to 4000 Å from an Aerobee rocket. Although the payload was capable of obtaining observations shortward of 2700 Å, the stellar flux was too weak for meaningful measurements below that wavelength. The most significant feature in the ultraviolet shortward of the atmospheric cutoff is an emission feature at 2800 Å identified as the resonance line of the Mg II doublet. (auth)

15914 TIME SCALES FOR Ca II EMISSION DECAY, ROTATIONAL BRAKING, AND LITHIUM DEPLETION. Skumanich, A. (National Center for Atomospheric Research, Boulder, Colo.). Astrophys. J.; 171: No. 3, 565-7(1 Feb 1972).

A comparison of the Ca^{+} emission luminosity—after correction for spectral-type effects—for the Pleiades, Ursa Major, and Hyades stars and the Sun indicate an emission decay that varies as the inverse square root of the age. Further, the rotational decay curve is found to satisfy the same law. It is further suggested that lithium depletion follows the same law but only as far as the Hyades age, after which the depletion proceeds exponentially. Since Ca^{+} emission is linearly proportional to magnetic field strength at the surface, one can predict that the surface fields are proportional to angular velocity and decay as the inverse square root. The above results are predicated on the standard Hyades age (0.4 billion years). (auth)

15915 PRE-MAIN-SEQUENCE STARS. I. LIGHT VARIABILITY, SHELLS, AND PULSATION IN NGC 2264. Breger, Michel (State Univ. of New York, Stony Brook). Astrophys. J.; 171: No. 3, 539-48(1 Feb 1972).

A light-variability study was undertaken in the young cluster NGC 2264. Among the nonpulsating pre-main-sequence A and F stars, only about 25% has shown short-period light variability or light variations since 1953. The variables are generally faint for their color or are cooler stars. A link with the variable cooler T Tauri stars is suggested. There exists a good correlation between light variability and (other) shell indicators. The variability data confirm previous suggestions that the fainter A/F stars are surrounded by thick shells and would be intrinsically much brighter. The general nonvariability of the brighter A/F stars may be interpreted as an absence of thick circumstellar dust shells. The scatter in the pre-main-sequence band in the color–magnitude diagram can only partially be explained by shells, and an age spread between 1 and 3×10^{6} years is indicated. Alternatively, should thick circumstellar shells be common, then these shells would have to be unusually stable. Shell expansion of less than 1% in radius within 15 years as well as timescales greater than 100 years between successive outbursts are required. W90, a star below the main sequence, has brightened by half a magnitude to V = 12.5 since 1953. The corresponding color variation suggests a ratio of total to selective extinction of about 9, somewhat incompatible with gray shell absorption and a proposed age of 2×10^{6} years derived from the use of classical evolutionary tracks. Two δ Scuti variables with periods of 3 hours were detected. Arguments for cluster membership are given. If cluster membership is confirmed, then they would be the first known Cepheid-like pre-main-sequence pulsators. The periods are short compared with similar post-main-sequence stars. This could be interpreted either as an unusually high mass or as pulsation in a higher harmonic. (auth)

15916 OVERTONES IN THE LIGHT CURVE OF CY AQUARII. Elst, Eric W. (Royal Observatory, Brussels). Astron. Astrophys.; 17: No. 1, 148-53(Feb 1972).

A harmonic analysis of the observations of Zissell (1968) revealed, in the light curve of CY Aquarii, a set of overtones. New observations (1970) are accordingly interpreted. (auth)

15917 MAGNITUDE OF THE SUPERNOVA IN M63 ON MAY 20, 1971. van Herk, G.; Schoenmaker, A. A. (Leiden Observatory). Astron. Astrophys.; 17: No. 1, 146-7(Feb 1972).

A revised value is given for the magnitude of the supernova in M63 on the evening of May 20, 1971. (auth)

15918 IS HD 45677 A VARIABLE STAR? Swings, J. P. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena); Swings, P. Astron. Astrophys.; 17: No. 1, 142-5(Feb 1972). (In French)

Whereas HD 45677 has faded by approximately one magnitude since 1969, the amplitude of variation in photographic magnitude between 1899 and 1969 has always been smaller than 0.3 mag. (auth)

15919 EVOLUTION OF A $5M_{\odot}$ STAR. Aizenman, M. L. (Institut d'Astrophysique, Cointe-Ougree, Belgium); Perdang, J.; Lesh, J. R. Astron. Astrophys.; 17: No. 1, 139-41(Feb 1972).

A $5M_{\odot}$ star having an initial chemical composition of X = 0.72, Y = 0.25, and Z = 0.03 is evolved to the stage where hydrogen burning in a thick shell takes place. This model is compared with other models having the same mass but different chemical compositions. (auth)

15920 BRIGHTNESS GRADIENTS FOR INTRINSICALLY VARIABLE CELESTIAL OBJECTS. Lukatskaya, F. I. (Main Astronomical Observatory, Kiev). Astron. Astrophys.; 17: No. 1, 97-105(Feb 1972).

Variations of photoelectric U, B, V magnitudes between maximum and minimum brightness of intrinsically variable celestial objects of different types are statistically proportional. The brightness gradients make it possible to suggest possible radiation mechanisms for variable stars consonant with UBV observations and to determine possible values of parameters for these mechanisms. They describe the processes of variability in their development. (W.D.M.)

15921 STARS WITH CENTRAL HELIUM BURNING AND THE OCCURRENCE OF LOOPS IN THE H–R DIAGRAM. III. HORIZONTAL BRANCH STARS. Lauterborn, D. (Hamburger Sternwarte, Hamburg); Refsdal, S.; Stabell, R. Astron. Astrophys.; 17: No. 1, 113-27(Feb 1972).

The structure and evolution of horizontal branch stars is discussed by considering separately the effects of changes in the mass, radius, and luminosity of the He core and the X profile

above the core. It is discussed why the type of evolutionary track mainly depends on the relative luminosity (L_c/L) of the He core. (auth)

15922 THEORETICAL EFFECT OF VARIOUS BROADENING PARAMETERS ON ULTRAVIOLET LINE PROFILES. Peytremann, E. (Smithsonian Institution Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.). Astron. Astrophys.; 17: No. 1, 76-82(Feb 1972).

The relative importance of various damping parameters in ultraviolet lines under conditions of normal stellar atmospheres ($10{,}000°K \leq T_{eff} \leq 30{,}000°K$, $\log g = 4$) was studied. It was found that the damping by electron collisions is always much smaller than either the radiative or the classical damping, except for lines that arise from high-excitation levels and do not therefore develop strong damping wings. A damping constant equal to 10 times the classical value is always much too large when compared to the more realistic (electron + radiative) damping. (auth)

15923 STUDY OF EMISSION IN NARROW-BAND PHOTOMETRY IN Be STARS. Peton, A.; Bigay, J. H.; Garnier, R.; Paturel, G. (Observatoire Meudon, France. Observatoire, Lyon). Astron. Astrophys.; 17: No. 1, 47-54(Feb 1972). (In French).

Comparisons between B and Be stars having the same intrinsic index $(U-B)_0$ show that the Be stars do not follow the B sequence. There are two causes that explain this: (1) an emission in the external shell of the star, with a corresponding shift of the point in the $(\alpha,(U-B)_0)$ and $(\beta,(U-B)_0)$ diagrams; and (2) the external shell causes a displacement of the $(U-B)_0$ index toward the red which is underestimated. Narrow-band photometry for emission measurements can only be used with Be stars for which the emission is much greater than the absorption by the envelope. Direct photoelectric measurements of Balmer decrements are compared with those obtained by conventional spectroscopy. The photoelectric indices E_α and E_β increase with the stars temperature. They are proportional to the equivalent widths W_α and W_β, measured by spectroscopy. The variation of the emission amplitude increases with the temperature of the star. The ratios E_α/E_β and H_α/H_β are proportional, and the scatter in the data is larger than can be explained by the precision of measurements. (auth)

15924 EFFECTS OF REDDENING ON UBV COLOR TRANSFORMATIONS. II. Gutierrez-Moreno, A.; Moreno, H. (Univ. de Chile, Santiago). Astron. Astrophys.; 17: No. 1, 41-6(Feb 1972).

The analysis of the effects of reddening on color-systems transformations was extended to larger reddenings, later type stars (F5), different interstellar absorption laws, and different types of transformations. It was found that no constant numerical coefficients are valid for the corrections to be added to the usual transformation formulae. General transformation equations, including reddened stars, may be represented by polynomials which use the reddening or both observed colors as parameters. (auth)

15925 SPECTRUM OF THE SUPERGIANT ϵ ORIONIS (B0 Ia). II. RADIAL VELOCITIES CURVE OF GROWTH ANALYSIS. Lamers, H. J. (Astronomical Inst. Utrecht). Astron. Astrophys.; 17: No. 1, 34-40(Feb 1972).

The visual spectrum of the supergiant ϵ Ori (B0 Ia, HD 37128) is discussed. Differential radial velocities are shown to be absent, except for Hα, which seems to show a negative velocity. A simple curve-of-growth analysis yields an ionization temperature of 25,000°K, except for Si which yields a somewhat lower temperature. The LTE abundances derived agree very well with those in τ Sco (B0 V), which may indicate that ϵ Ori has not yet passed through the red-giant stage. The microturbulent velocity is at least 16 km/s and possibly 28 km/s. The presence of the two unidentified emission lines at 4500 Å is reported, as well as some indications that line emission fills in several absorption lines, which are characteristic for Of stars. (auth)

15926 ANALYSIS OF THE METAL-POOR RED GIANT STAR HD 122563. Wolffram, W. (Univ., Kiel). Astron. Astrophys.; 17: No. 1, 17-33(Feb 1972). (In German).

The extremely metal-poor K giant HD 122563 was analyzed, using nongrey model atmospheres. Flux constancy was obtained following Lucy's iteration procedure. Rayleigh scattering was explicitly taken into account in the calculation of the opacity and the source function. The Rayleigh scattering affects the temperature stratification as well as the continuous and line spectra. These effects were studied using a simple Milne–Eddington approximation. The model was corrected for line blanketing and convection. (W.D.M.)

15927 INVESTIGATIONS ON THE STRUCTURE OF W UMa STARS. Mauder, H. (Univ., Erlangen, Ger.). Astron. Astrophys.; 17: No. 1, 1-16(Feb 1972).

Starting with the rectifiable model and the Roche model for W UMa stars, it is shown that the photometric elements depend remarkably on the rectification procedure. Taking into account this effect, the photometric elements for 34 W UMa systems are recalculated and a catalogue of preliminary elements is given. On the basis of these results, the model of Lucy (1968) for W UMa stars is tested. It is shown that the theoretically expected color-mass relation is indicated; however, the postulation of a common convective envelope in the meaning of Lucy's model is in contradiction to the observations. Nevertheless, it is shown that a small contact of both components cannot be excluded. Whether the components can be regarded as main-sequence stars can be proved only after a theoretical calculation of the anomalous behavior of the luminosities with respect to possible contact. From an estimate of the reflection effect it follows that this effect is not sufficient for an explanation of the reddening in the minima. A discussion of the arguments leads to the conclusion that the W UMa stars very probably are contact systems. (auth)

15928 HELIUM CONTENT OF M92 DEDUCED FROM THE SUBGIANT LUMINOSITY FUNCTION. Faulkner, J. (Univ. of California, Santa Cruz). Nature (London) Phys. Sci.; 235: No. 54, 27(10 Jan 1972).

A discussion is presented regarding what can be said about the He content of M92 on the basis of recent stellar models. From considerations of the luminosity function in the subgiant luminosity function region prima facie evidence is found for a high He content. The importance of accurate observational work with large telescopes on globular clusters is emphasized. (UK)

15929 LITHIUM ABUNDANCES OF STARS IN OPEN CLUSTERS. Zappala, R. R. (Univ. of California, Santa Cruz). Astrophys. J.; 172: No. 1, 57-74(15 Feb 1972).

Image-intensifier instrumentation was used at the coudé focus of the Lick 120-inch reflector to obtain spectrograms of F to K main-sequence stars in the Hyades, Pleiades, and Praesepe clusters, as well as stars still contracting toward the main sequence in NGC 2264. The abundance of lithium was calculated from the measured equivalent widths of Li I λ6707, a grid of model atmospheres, and an empirical correction for saturation effects. Lithium is present in NGC 2264 in about the same amount as in F and early-G cluster main-sequence stars. No Li abundances are observed to exceed the present interstellar upper limit. Because of possible differences in initial Li content among clusters, it is difficult to separate the effects of depletion during pre-main-sequence evolution from later slow destruction on the main sequence. However, the Pleiades G and K stars appear to be genuinely overabundant in Li with respect to the Hyades and imply a main-sequence depletion time scale of 1.5×10^9 years for solar-type stars, decreasing to about half this value for K0 V stars. If Pleiades abundances represent zero-age main-sequence values, a shift of about +0.12 in B – V is necessary to bring Bodenheimer's theoretical relation between pre-main-sequence depletion and color into agreement with the observations. (auth)

15930 SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS OF M SUPERGIANTS IN CARINA. Humphreys, Roberta M. (Steward Observatory, Tucson, Ariz.); Strecker, Donald W.; Ney, E. P. Astrophys. J.; 172: No. 1, 75-88(15 Feb 1972).

Thirty southern-hemisphere M supergiants mostly in Carina were studied spectroscopically in the blue and near-infrared and photometrically from 0.4 to 18 μ. The uncertainties in the determinations of interstellar extinction are discussed, and the spatial distribution of the M supergiants in the Carina arm is shown. The presence of the 11-μ excess attributed to silicate dust is a common feature. Stars of the same spectral type and luminosity class are remarkably homogeneous in their long-wave behavior. The silicate feature becomes more prominent in the more luminous stars and in stars of later spectral type. Four composite systems show little long-wave excess. The two VV Cephei objects have excesses probably produced by gas emission, and the other two have little or no excess—supporting the suggestion that the presence of the early star prohibits the formation of a dust envelope. Three stars—VY CMa, VX Sgr, and HD 97671—appear to be extreme examples of stars with large excesses over the entire long-wave region. It is suggested that these objects are surrounded by large amounts of particulate material over a great range of distances from the stars. The term "dust thermosphere" is used to describe this material, which absorbs much of the stellar energy and reradiates it at long wavelengths. The objects with dust thermospheres are shown to be very luminous with most of their energy in the 2- to 20-μ region. The absolute bolometric magnitudes inferred are: VY CMa, −9.5; VX Sgr, −8.1; and HD 97671, −6.8. (auth)

15931 ASTRONOMICAL INFRARED SPECTROSCOPY WITH A CONNES-TYPE INTERFEROMETER. III. ALPHA ORIONIS, 2600 TO 3450 cm^{-1}. Beer, Reinhard (California Inst. of Tech., Pasadena); Hutchison, Robert B.; Norton, Robert H.; Lambert, David L. Astrophys. J.; 172: No. 1, 89-115(15 Feb 1972).

Recent spectra of α Ori in the 3- to 4-μ region at a resolving power of about 10,000 show clear evidence of the $\Delta v = 1$ sequence of the rotation–vibration bands of OH. A detailed investigation of the rotational and vibrational populations suggests that the OH is close to being in LTE at an apparent temperature of 4100 ± 200°K. An OH abundance of 1.2×10^{20} molecules cm^{-2} and upper limits for H_2O and $H^{35}Cl$ of 8×10^{18} and 8×10^{17} molecules cm^{-2} were deduced and the rms turbulence velocity in the region of OH line formation was 11.5 ± 2 km s^{-1}. The implications of these data on abundances in M supergiant atmospheres are discussed. (auth)

15932 UNIDENTIFIED BANDS IN THE NEAR-INFRARED SPECTRUM OF S LYRAE. Wyckoff, S.; Wehinger, P. (Univ. of Kansas, Lawrence). Astrophys. J.; 172: No. 1, 117-19(15 Feb 1972).

The near-infrared minimum-light spectrum of S Lyr was found to exhibit the four unidentified bands previously observed in S-type spectra. Measured wavelengths of the band heads are given, and possible molecular sources are discussed. (auth)

15933 FORBIDDEN EMISSION LINES OF Mn I AND Fe II IN THE SPECTRA OF LONG-PERIOD VARIABLES NEAR MINIMUM LIGHT. Nussbaumer, H. (Univ. of Colorado, Boulder); Swings, J. P. Astrophys. J.; 172: No. 1, 121-8(15 Feb 1972).

The behavior of the emission-line intensities of Mn I and [Mn I] in spectra of the long-period variable χ Cygni is discussed. Departures from a statistical distribution of the metastable levels occur in the cases of neutral manganese and singly ionized iron, as seen from relative intensities of [Mn I] and [Fe II] lines in the spectra of several Mira variables near minimum light. The magnetic dipole and electric quadrupole transition probabilities are computed for the configurations $3d^54s^2$ and $3d^64s$ of Mn I. (auth)

15934 ROCKET SPECTROSCOPY OF ZETA ORIONIS. Smith, Andrew M. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 172: No. 1, 129-48(15 Feb 1972).

A spectrum of ζ Ori extending from 922 to 1453 Å with approximately 0.8 Å resolution was recorded at rocket altitudes. All lines used in existing models of stellar atmospheres appear in the recorded spectrum with the exception of those masked by telluric N_2 or strong P Cygni-type profiles and by an O v line at 1371.29 Å. (W.D.M.)

15935 SPACE MOTIONS OF K3–M2 DWARFS IN THE SOLAR NEIGHBORHOOD. Upgren, A. R. (Wesleyan Univ., Middletown, Conn.). Astrophys. J.; 172: No. 1, 149-54(15 Feb 1972).

Space motions were determined from parallaxes, proper motions, and radial velocities of 62 dwarfs with B–V color indices between +0.95 and +1.55 (corresponding to K3 V and M2 V on the MK classification system). The precision and homogeneity in all of the observations and the absence of a selection effect favoring high-velocity stars allowed a sample to be defined that is more truly representative of K–M dwarfs in the solar vicinity than has been heretofore possible. In the past, samples have been comprised mostly of stars listed in the Yale General Catalog of Trigonometric Stellar Parallaxes. Such a sample is the one of Kron, Gascoigne, and White, which is shown to incorporate a disproportionately large number of high-velocity stars as indicated by their space motions. However, the main sequence that it defines is not significantly different from that of the stars included here. An analysis of the space motions of the K3–M2 dwarfs yielded 18.0 km s^{-1} for the solar motion with apex at 19h48m(297°), +53° (1950). The U-, V-, and W-axes of the velocity ellipsoid were 28.7, 19.1, and 15.1 km s^{-1}, respectively and the vertex deviation is 16°. These results are compared with earlier analyses; agreement is close only for the more recent ones that take velocity selection effects into account. (auth)

15936 THERMOHALINE CONVECTION IN STELLAR INTERIORS. Ulrich, Roger K. (Univ. of California, Los Angeles). Astrophys. J.; 172: No. 1, 165-77(15 Feb 1972).

A quantitative theory of mixing induced by an inverted gradient of mean molecular weight is presented. This theory is applied to three stellar problems, with the following results: (1) during ^3He burning in a 2 $M_\odot$ star, the change of X_3 between the center and surface is 0.002; (2) the μ mechanism proposed by Stothers and Simon is too short-lived to explain the β Cephei variables, and (3) after the initial ignition of ^4He burning in a degenerate shell flash, the ^4He core and the ^{12}C shell mix on a time scale greater than 10^6 years. The theory is checked by comparison with the laboratory experiment by Stommel and Faller quoted by Stern. The agreement is satisfactory. An important uncertainty in the theory is the ratio of length to width of a moving finger of matter. (auth)

15937 RELATIVITY PARAMETER AT HIGH DEGENERACY. Mitalas, R. (Univ. of Western Ontario, London). Astrophys. J.; 172: No. 1, 179-80(15 Feb 1972).

It is emphasized that the relativity parameter under conditions of high degeneracy is not $\beta = KT/mc^2$ but $\beta' = \beta\psi$, where ψ is the degeneracy parameter. (auth)

15938 RADIAL PULSATIONS OF PRE-WHITE-DWARF STARS. I. LINEAR QUASI-ADIABATIC ANALYSIS. Van Horn, H. M. (Univ. of Rochester, N. Y.); Richardson, M. B.; Hansen, Carl J. Astrophys. J.; 172: No. 1, 181-99(15 Feb 1972).

Numerical calculations of the periods, eigenfunctions, and stability integrals in the quasi-adiabatic limit were carried out for the lowest radial pulsation modes of homogeneous, pre-white-dwarf stellar models. Detailed numerical results are given, and the effects of neutrino emission, differences in stellar mass, and structural changes accompanying the evolution are discussed. (auth)

15939 Fe I OSCILLATOR STRENGTHS DETERMINED FROM ANOMALOUS DISPERSION OF SHOCK-HEATED GASES. Huber, Martin C. E.; Parkinson, W. H. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J.; 172: No. 1, 229-47(15 Feb 1972).

Fe I oscillator strengths measured by the hook method on shock-heated gases are reported. Within the given errors these values agree with oscillator strengths obtained by other methods, including wall-stabilized arc and shock-tube emission, the beam-foil technique, and delayed-coincidence measurements, except that the data reported tend to be somewhat higher. If one assumes no change in atmospheric models, the f-value scale would suggest a solar abundance at the lower limit of the recently published values, namely, $\log (A_{Fe}/A_H) + 12 = 7.4$. This study demonstrates the effectiveness of the hook method for quantitative spectroscopy on shock-heated gases and points up its usefulness for gas diagnostics on optically thick lines. (auth)

15940 RADIATIVE RECOMBINATION OF HYDROGENIC IONS IN HIGH-TEMPERATURE PLASMAS. Gratreau, P.; Robouch, B. V. (EURATOM-CNEN, Rome). Astrophys. J.; 172: No. 1, 201-3(15 Feb 1972).

The rate of recombination and the rate of the mean kinetic energy loss of recombining electrons were calculated numerically, with a precision of better than 1%, using the expressions of Karzas and Latter, and compared with the values reported by Seaton. The results show that Seaton's estimate of the uncertainty of his results is pessimistic. (auth)

15941 STELLAR X RADIATION BY THE DECELERATION PROCESS. Schocken, Klaus (George C. Marshall Space Flight Center, Huntsville, Ala.). Acta Phys. Austr.; 32: No. 3-4, 209-14(Mar 1970).

A binary system originates with or results from the splitting of a single star into two components, caused by rotational instability during the contraction of the star. The assumption is made that, to become a nova, it is a necessary condition for the star to be a member of a close binary system consisting of a blue and a red star, with a stream of gas flowing from the red to the blue star and forming a shell around the blue star to generate the observed bright emission lines that indicate that this gaseous shell moves with the blue star. Assuming that the explosive process has taken place in the nova, a shock wave will penetrate the surface, forming an expanded atmosphere in a time that is too short for appreciable loss of radiation. When an electric field exists in a plasma with a density such that the electrons whose velocity surpasses a certain critical value will gain more energy from the field than they lose by collisions, runaway electrons will be generated. The hypothesis is made that runaway electrons are the source of deceleration X radiation in the atmosphere of a nova. (auth)

15942 THERMONUCLEAR REACTION RATES. Fowler, William A.; Caughlan, Georgeanne R.; Zimmerman, Barbara A. (California Inst. of Tech., Pasadena. Montana State Univ., Bozeman). Annu. Rev. Astron. Astrophys.; 5: 525-70(1967).

The available experimental data on cross sections for the nuclear interactions of neutrons, protons, and alpha particles with a number of light and intermediate-mass nuclei are reviewed, and calculations are presented on the resulting reaction rates, nuclear lifetimes, and energy generation rates under astrophysical conditions. Considerations are restricted to nondegenerate, nonrelativistic circumstances for the interacting nuclei. (W.D.M.)

15943 INTRINSIC POLARIZATION OF RADIATION FROM RY PERSEI. Shulov, O. S.; Gudkova, G. A. (Leningrad State

Univ.). Astrophysics (Eng. Transl.); 5: No. 3, 237-41(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 477-85(1969).

The average dependence of polarization on phase based on 230 individual observations was found for the eclipsing binary RY Persei. The interstellar component of the polarization was determined by studying the interstellar polarization of 24 stars in the neighborhood of RY Persei, and the intrinsic polarization of the binary as a function of phase was isolated. The intrinsic polarization of RY Persei radiation was interpreted as being due to the scattering of light from the components of the binary by free electrons in the disk-shaped gas nebula surrounding the principal star. The mass of this nebula was estimated as 2.6×10^{-11} $m_{\odot}$. (auth)

15944 REMARKABLE FLARE STARS IN THE PLEIADES. Parsamyan, E. S.; Chavushyan, O. S. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Eng. Transl.); 5: No. 3, 247-9(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 499-502(1969).

The frequency of flares from VZP 101 and H II 357 in the Pleiades is discussed. (W.D.M.)

15945 ELLIPTICITY OF SLOWLY ROTATING CONFIGURATIONS. Seidov, Z. F. (Shemakhin Astrophysical Observatory, Baku). Astrophysics (Eng. Transl.); 5: No. 3, 250(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 503-5(1969).

It is shown that the limits for $5m/4\sigma$ from Clairaut's equations are more accurate than the limits given by Chandrasekhar and Roberts. Results of calculations based on these equations are listed, using the Emden functions for the polytropes and the Chandrasekhar functions for white dwarfs. (W.D.M.)

15946 LIGHT CURVES OF FLARE STARS. Gurzadyan, G. A. (Byurakan Astrophysical Observatory Branch for Cosmic Investigation, Erevan). Astrophysics (Eng. Transl.); 5: No. 3, 178-83 (Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 383-92(1969).

The usual formula $J \sim e^{-\beta t}$ for intensity after a flare maximum is in poor agreement with observations. A different interpretation of the light curves of flare stars is proposed based on the fast-electron hypothesis. It is shown that the reduction in intensity is exclusively due to the expansion of the envelope consisting of fast electrons. The electron energy-loss effect is negligible. Formulas are given that are in good agreement with the observed light curves of flare stars between the maximum and the end of the flare. The concept of the "dynamic parameters" of a flare is introduced, and the magnitudes of these parameters are determined for more than twenty flare stars. (auth)

15947 EFFECT OF ELECTRON SCREENING IN NUCLEAR REACTIONS AT HIGH DENSITIES. Porfir'ev, V. V.; Redkoborodyi, Yu. N. (Main Astronomical Observatory, Kiev). Astrophysics (Eng. Transl.); 5: No. 3, 184-91(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 393-413(1969).

Electron screening of the nuclear Coulomb field is analyzed, a process which leads to an increase in the rate of thermonuclear reactions. The effective potential was calculated by means of the self-consistent field based on the Hartree–Fock approximation, in which the condition that the motion of the electron be quasiclassical need not be satisfied. The effect of the two nuclei participating in the reaction on the screening-charge distribution was taken into account. An expression for the correction to the nuclear interaction energy was obtained with allowance for the self-energy of the screening electron cloud. For small internuclear distances, this correction was found to be independent of the degree of nonrelativistic degeneracy of the electron gas. The correction factor to the thermonuclear reaction rate which represents the screening effect was derived for the region between the nucleus and the envelope of a white dwarf ($T \sim 10^7$ °K; $\rho = 10^2$ to 10^6 g/cm^3). The dependence of the correction factor on density, temperature, and degree of degeneracy was essentially different from that reported earlier. (auth)

15948 EQUILIBRIUM STATES OF A SYSTEM OF GRAVITATING PARTICLES. Bisnovatyi-Kogan, G. S.; Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Astrophysics (Eng. Transl.); 5: No. 3, 198-200(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 425-31(1969).

A derivation is given for the self-consistent solution of the kinetic equation in the intrinsic gravitational field, which depends on two constants of motion, namely, the energy and the square of the angular momentum. Solutions with an aribtrary degree of anisotropy in velocity space are found for a sphere and a cylinder. In the isotropic case of a sphere the solutions are the collisionless analogs of polytropic solutions. Degenerate solutions with elliptical orbits and gravitational potential $\Phi = \alpha + \beta r^2$ are obtained for a sphere, a cylinder, and a disk. (auth)

15949 VELOCITY DISTRIBUTION FUNCTION FOR BODIES OF SMALL MASS IN CLUSTERS. Kaliberda, V. S. (Leningrad State Univ.). Astrophysics (Eng. Transl.); 5: No. 3, 201-5(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 433-41(1969).

The velocity distribution function is found for stars in nonrotating systems. It is assumed that the field stars have equal masses, whereas the mass of the star under consideration is zero. Multiple stellar encounters are taken into account. The energy carried off by dissipating stars and the rate of dissipation are found. It is shown that a spread in mass accelerates the evolution of stellar systems. (auth)

15950 PHOTOELECTRIC PHOTOMETRY OF THE WOLF–RAYET BINARY HD 211853. Guseinzade, A. A. (Shemakhin Astrophysical Observatory, Baku). Astrophysics (Eng. Transl.); 5: No. 3, 249(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 502-3(1969).

Photoelectric observations of HD 211853 were performed in 1964–1965 in three colors, using α photometric system close to the U, B, V system. Observations showed that the variation in the light of HD 211853 is irregular throughout a given night. (W.D.M.)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 15908 and 15999.

15951 (NP-19148) HIGH-ENERGY PARTICLES IN COSMIC RADIATION SOURCES. Grewing, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). [nd]. 23p. (In German). Dep. NTIS (U. S. Sales Only).

The incidence of high-energy particles in supernovae, radiogalaxies, quasars, and pulsars is discussed. (J.S.R.)

15952 SPECTRUM OF LOW-ENERGY GAMMA RADIATION FROM THE GALACTIC-CENTER REGION. Johnson III, W. N.; Harnden, F. R. Jr.; Haymes, R. C. (Rice Univ., Houston, Tex.). Astrophys. J.; 172: No. 1, L1-7(15 Feb 1972).

A balloon-altitude observation was conducted November 25, 1970 of the galactic-center region, at energies between 23 and 930 keV. The radiation detected from the 24° FWHM area of Sagittarius during the 7-hour observation has a differential photon number spectrum that may be approximated by a power law with a spectral index of 2.37 ± 0.05; this is in satisfactory accord with the results obtained previously by others at low energies. In addition, the evidence for a spectral feature at 0.5 MeV is presented and discussed. (auth)

15953 NATURE OF THE MONOCEROS SUPERNOVA REMNANT. Gebel, William L. (State Univ. of New York, Stony Brook); Shore, S. N. Astrophys. J.; 172: No. 1, L9-12(15 Feb 1972).

A dynamical expansion time of 3×10^5 years and an envelope of 100 km s^{-1} were derived for the filamentary Monoceros Loop supernova remnant. Through arguments connecting three O stars with the supernova remnant, a lower limit of 25 to 30 $M_{\odot}$ was derived for the progenitor star. A thermal soft x-ray point source located at $\alpha(1950) = 6h35m5$, $\delta(1950) = +6°28'$ was predicted based on the hypothesis of a cooling neutron star. By analogy, the Cygnus Loop x-ray source was interpreted as a neutron star. (auth)

15954 DYNAMIC SPECTRUM ANALYSIS OF CYGNUS X-1. Oda, M.; Wada, M.; Matsuoka, M.; (and others) (Tokyo Univ.). Astrophys. J.; 172: No. 1, L13-16(15 Feb 1972).

The oscillatory structure of the counting-rate data trains of Cyg X-1 obtained by the AS&E and the M.I.T. group was studied. Instead of applying the Cooley–Tukey fast Fourier-transform algorithm to the entire data, the dynamic spectrum was obtained by fitting the wave with time sections of the data trains. Also, the Hissagram, which is a quantitative exhibition of the sonagram, was produced for the same train. It was concluded that the oscillation lasts typically for several seconds and its frequency drifts within a few seconds repeatedly. (auth)

15955 SEARCH FOR PULSED RADIO EMISSION FROM SCORPIUS X-1 AND CYGNUS X-1. Taylor, J. H.; Huguenin, G. R.; Hirsch, R. M. (Univ. of Massachusetts, Amherst). Astrophys. J.; 172: No. 1, L17-19(15 Feb 1972).

Analysis of radio emission at 400 MHz from the direction of Sco X-1 and Cyg X-1, by means of a sensitive de-dispersing technique, has revealed no pulses exceeding approximately 0.05×10^{-26} J m^{-2} Hz^{-1} over 5-ms intervals. Considered together with the negative results of previous searches for periodic radio emission, these results show that Sco X-1 and Cyg X-1 do not radiate detectable amounts of pulsar-like emission. (auth)

15956 LIGHT VARIATION OF THE QUASAR 3C 273. Jurkevich, I. (Univ. of Pennsylvania, Philadelphia. General Electric Co., Philadelphia). Astrophys. J.; 172: No. 1, L29-33(15 Feb 1972).

A new search for periodicities in the light fluctuations of the quasar 3C 273 was carried out. The latest compilation of observations made by Angione was used in the analysis. It is shown that the confidence level with which resonances corresponding to periods in the range of 8 to 10 and 14 to 17 years are determined is too low to permit unequivocal claims concerning their reality. (auth)

15957 PARKES SURVEY OF 21-CENTIMETER ABSORPTION IN DISCRETE-SOURCE SPECTRA. I. THE PARKES HYDROGEN-LINE INTERFEROMETER. Radhakrishnan, V.; Brooks, J. W.; Goss, W. M.; Murray, J. D.; Schwarz, U. J. (CSIRO, Sydney). Astrophys. J., Suppl. Ser.; 24: No. 203, 1-14(Jan 1972).

A multichannel 21-cm-line interferometer is now in regular operation at the Parkes Observatory. The instrument which incorporates certain novel features is described. Among the more interesting of the early observations made with this instrument are the detection of extragalactic H I absorption in the Large Magellanic Cloud and evidence of small-scale structure in the galactic H I concentrations in the direction of Orion A. (auth)

15958 PARKES SURVEY OF 21-CENTIMETER ABSORPTION IN DISCRETE-SOURCE SPECTRA. III. 21-CENTIMETER ABSORPTION MEASUREMENTS ON 41 GALACTIC SOURCES NORTH OF DECLINATION -48^0. Radhakrishnan, V.; Goss, W. M.; Murray, J. D.; Brooks, J. W. (CSIRO, Sydney). Astrophys. J., Suppl. Ser.; 24: No. 203, 49-121(Jan 1972).

Forty-one galactic sources north of declination –48° were observed for 21-cm absorption by using the single-dish and/or interferometer methods. The difficulties encountered by both methods on sources in the galactic plane are discussed. Detailed notes are presented for each source, together with the reference emission and absorption profiles and tables summarizing all the data. (auth)

15959 PARKES SURVEY OF 21-CENTIMETER ABSORPTION IN DISCRETE-SOURCE SPECTRA. IV. 21-CENTIMETER ABSOPRTION MEASUREMENTS ON LOW-LATITUDE SOURCES SOUTH OF DECLINATION -46^0. Goss, W. M.; Radhakrishnan, V.; Brooks, J. W.; Murray, J. D. (CSIRO, Sydney). Astrophys. J., Suppl. Ser.; 24: No. 203, 123-59(Jan 1972).

Twenty-one low-latitude sources in the range $280° < l < 340°$ were observed for 21-cm absorption by using the Parkes 64-m telescope; twelve of these sources were also investigated with the 64-m/18-m interferometer. Distance estimates and detailed notes are presented for each source, together with profiles and tables summarizing all the data on the sources. The H I evidence on two of these sources is in support of the view that they are extragalactic. (auth)

15960 PARKES SURVEY OF 21-CENTIMETER ABSORPTION IN DISCRETE-SOURCE SPECTRA. V. NOTE ON THE STATISTICS OF ABSORBING H I CONCENTRATIONS IN THE GALACTIC DISK. Radhakrishnan, V.; Goss, W. M. (CSIRO, Sydney). Astrophys. J., Suppl. Ser.; 24: No. 203, 161-6(Jan 1972).

A statistical analysis of the parameters of Gaussian components fitted to the absorption spectra presented in the preceding two papers leads to the conclusion that the hydrogen seen in absorption in the galactic disk has a mean value for N_H/T_s of 1.5×10^{19} atoms cm^{-2} $°K^{-1}$ kpc^{-1}. A line of sight along the plane intersects on the average a minimum of 2.5 concentrations per kiloparsec. (auth)

15961 PROBABLE PRECURSOR TO THE X-RAY NOVA CENTAURUS XR-4. Belian, R. D.; Conner, J. P.; Evans, W. D. (Los Alamos Scientific Lab., N. Mex.). Astrophys. J.; 171: No. 3, L87-90(1 Feb 1972).

A short-lived burst of x rays from a region of the sky containing Cen XR-4 occurred on July 7, 1969 at 0152 UT, about 50 hours before the first reported observation of the x-ray nova outburst of Cen XR-4. The event was observable above background for a period of about 10 minutes. If the event was due to Cen XR-4, its maximum intensity was more than twice the maximum reported for the subsequent x-ray nova and more than 4 times that of Sco X-1 in a nonflaring state. (auth)

15962 DISTRIBUTION OF OH IN THE GALAXY. I. CORRELATION WITH CONTINUUM SOURCES AND WITH FORMALDEHYDE. Turner, B. E. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J.; 171: No. 3, 503-18 (1 Feb 1972).

A survey of the Galaxy in the region $337° \leq l \leq 75°$, $-2° \leq b \leq +2°$ revealed OH absorption or emission in 180 new sources in a total of 264 directions searched to a limit of 0.7 f.u. The survey was quite strongly selective toward directions of continuum sources. This was also true of recent surveys in the 6-cm line of formaldehyde. The number of OH and H_2CO clouds is large enough to warrant a statistical study of the association of OH with H_2CO and with continuum sources. It was found that the apparent optical depth $\langle\tau_{OH}\rangle$ was not correlated with the continuum source brightness nor with the OH velocity relative to the velocity of the H109α recombination line. $\langle\tau_{OH}\rangle$ was also not correlated with $\langle\tau_{H_2CO}\rangle$. However, the number of OH clouds increased as the velocity difference from the H109α line decreased. Also, the OH and H_2CO velocities were correlated, although not very closely. It was concluded on this and other arguments that OH clouds are not intimately associated with either H II regions or with H_2CO clouds, although these three types of objects tend to exist in the same general regions of spiral arms where the overall gas density is highest. (auth)

15963 SOFT X-RAY SURVEY FROM THE GALACTIC CENTER TO VELA. Hill, R. W.; Burginyon, G.; Grader, R. J.; (and others) (Univ. of California, Livermore). Astrophys. J.; 171: No. 3, 519-28(1 Feb 1972).

A 640 cm^2 proportional-counter system, sensitive from 0.2 to 12 keV, was used to survey the galactic plane from Sagittarius to Vela. Spatial resolution was 1°, at best. The soft x-ray sky is dominated by a region of strong emission in the vicinity of Vela X and has an appearance quite different from the sky viewed at photon energies of a few kilovolts. Many sources were located in one dimension in the direction of the galactic center. Some of these positions agree well with those of previous experiments. Locations were derived for two strong sources; GX 292 + 0 or Cen 3, and GX 322 + 0 or Cir 1. Positions are restricted to a region with area less than 0.2 square degrees. Another weaker source, GX 296 – 2 or Cen 5, was located in a region of area 0.6 square degrees. A definite source of soft x rays, which seems to coincide with the object η Car, was seen. The source Nor 1 was found to emit a greater flux of soft x rays than other surrounding objects relative to its overall strength. Spectra are derived for all sources, and numbers are given for interstellar material in the line of sight. (auth)

15964 POSSIBLE OBSERVATION OF HIGH-ENERGY GAMMA RAYS FROM THE CYGNUS REGION. Niel, M. (CESR, Toulouse); Vedrenne, G.; Bouigue, R. Astrophys. J.; 171: No. 3, 529-36(1 Feb 1972).

Results of two high-altitude balloon flights with a spark-chamber γ-ray telescope have shown the existence, from the Cygnus region, of a significant γ-ray flux at the 2.5 σ confidence level. Taking into account the angular resolution of the detector, it seems possible to interpret this flux as associated either with an extended source or with unresolved sources, in a zone between $l^{II} \simeq 65$ and $80°$, $b^{II} \simeq -6$ to 18°, giving an intensity of about $(6 \pm 3) \times 10^{-5}$ γ's cm^{-2} s^{-1} for energies greater than 60 MeV. (auth)

15965 INTERCONTINENTAL RADIO ASTRONOMY. Kellermann, K. I. Sci. Amer.; 226: No. 2, 72-83(Feb 1972).

Examination of the structure of quasars, radio galaxies, and galactic OH and water vapor sources with interferometers consisting of radio telescopes separated by distances on the order of the diameter of the Earth is considered. Past developments and future possibilities are discussed. (W.D.M.)

15966 ORIGIN OF THE ABSORPTION LINES IN QUASAR SPECTRA. Roeder, R. C. (Univ. of Toronto). Astrophys. J.; 171: No. 3, 451-6(1 Feb 1972).

The application of Bahcall and Peebles's statistical test (Astrophys. J. Lett., 153: 689(1969)) for the origin of the absorption lines found in quasar spectra was extended. The test was carried out by using several model universes and different values of z_c, the cutoff redshift. Any conclusion about the validity of the cosmological origin of the absorption lines is seen to depend, in the case of multiple redshifts, upon z_c and the cosmological model. (auth)

15967 INFLUENCE OF FAST PARTICLES ON THE OPTICAL EMISSION LINE SPECTRUM OF A NEBULA: THE BALMER DECREMENT. Aldrovandi, S. M. V.; Pequignot, D. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 17: No. 1, 88-96(Feb 1972).

The effect of a monoenergetic flux of relativistic electrons on the relative intensity of the Balmer lines of a nebula was studied. This effect was first evaluated taking into account only its influence through excitation of the gas, without solving ionization and thermal balances, so that the electron temperature and degree of ionization are given parameters. As the relativistic flux increases, the Balmer decrement can become more steep or less steep, depending on the values of these two parameters. Secondly, for a pure hydrogen gas, assuming that the relativistic electrons are the only source of energy, ionization and thermal balances were solved, and it was found that the Balmer decrement becomes steeper with increasing flux. (auth)

15968 GEOMETRICAL INTERPRETATION OF THE LUMINOSITY OF QUASARS. Le Floch, A. C.; Lebreton, J. (Faculte des Sciences, Tours, France). Nature (London) Phys. Sci.; 235: No. 54, 24-6(10 Jan 1972).

It is stated that it is possible to explain some aspects of the luminosity of quasars from simple considerations of Minkowskian geometry, and it is proposed that quasars resulted from one or more big bangs distinct from that which produced the matter contained in galaxies of our own type. The properties of quasar luminosity and elementary considerations of Minkowskian geometry allow placing the quasar big bang in a specific region of space–time. (UK)

15969 LONG-TERM INTENSITY VARIATIONS OF PULSARS OBSERVED AT TWO FREQUENCIES. Hesse, K. H. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 235: No. 54, 27-9 (10 Jan 1972).

Observations of CP 0808, 0834, and 1919 at 81.5 and 151 MHz are described, and a comparison of the daily intensities at the two frequencies was made. Details are given of the receiving systems and techniques employed, and results are shown graphically. It was concluded that it is unreasonable to attribute the long-term intensity variations to interstellar scintillation. The possibility arises that giant clouds, such as those that might exist in the outer regions of an old supernova remnant, could give rise to periods of enhanced activity by a refraction or reflexion effect. Such fluctuations would be indistinguishable from the effects of interstellar scintillations, and the value of electron density required for such a cloud is no greater than exists in a typical supernova remnant and would not give rise to observable effects from thermal emission or contribution to pulsar dispersion measures. It is concluded that long-term variations could be considered either intrinsic to the pulsar or to arise from the foregoing propagation effect. In the latter case, however, the magnitude of the long-term variations would be considerably reduced at higher frequencies because the reduced refraction and correlation evidence is against this. If the variations are intrinsic, good frequency correlation could be expected from most current pulsar models, where the radiation is considered to be emitted from a localized region near the pulsar. (UK)

15970 MECHANISM FOR THE X-RAY PULSATIONS IN CYG X-1. Blumenthal, G. R.; Tucker, W. H. (American Science and Engineering, Cambridge, Mass.). Nature (London); 235: No. 5333, 97-8(14 Jan 1972).

A mechanism is suggested for production of the observed x-ray pulsations from Cyg X-1 and other sources that show similar behavior. It is postulated that the pulsations are related to oscillations in a region of high magnetic field produced by giant flare-like events. The fact that pulse trains occur at various non-repeating periods makes it difficult to account for the structure of Cyg X-1 in terms of the mechanics of large masses; localized activity, in analogy with solar flares, seems more plausible. The general picture is that a flare occurs in a region of high magnetic field on the surface of the star, resulting in oscillations in the magnetic-field structure. These oscillations lead to heating of the plasma in a flux tube that emits thermal radiation, the heating being caused by magnetic pumping or particles accelerated in periodic bursts by the flare. Synchrotron radiation from high-energy particles accounts for hard x-ray emission. This model for the x-ray emission ignores the question of the ultimate source of the magnetic field energy producing the pulsations. The flares must occur on the surface or in the magnetospheres of the star, but the star could be a neutron star, white dwarf, or any conventional star capable of generating $\geq 10^{37}$ ergs/sec. (UK)

15971 MICROQUAKES AND MACROQUAKES IN NEUTRON STARS. Pines, David; Shaham, Jacob (Univ. of Illinois, Urbana). Nature (London) Phys. Sci.; 235: No. 55, 43-9(17 Jan 1972).

It is stated that many of the properties of pulsars, particularly those of the Crab Nebula and Vela pulsars, can be explained in terms of microquakes and macroquakes. (auth)

15972 OPTICAL VARIABILITY OF 20.08.01 CANCRI. Wenzel, W. (Sternwarte, Sonneberg, Ger.). Nature (London) Phys. Sci.; 235: No. 55, 58(17 Jan 1972).

It is stated that the variations of this radio object in the photographic spectral region are of great significance. Data obtained from the Sonneberg plates are discussed. Co-ordinated spectroscopic, photometric, and radio observations are needed. (UK)

15973 TIME DEPENDENCE OF EMISSION-LINE STRENGTHS FROM A PHOTOIONIZED NEBULA. Bahcall, John N. (California Inst. of Tech., Pasadena. Tel Aviv Univ., Israel); Kozlovsky, Ben-Zion; Salpeter, E. E. Contract AT(11-1)-68. Astrophys. J.; 171: No. 3, 467-82(1 Feb 1972).

Discussions are given for the time dependence of emission-line intensities from nebulae that are photoionized by a central source with a variable continuum flux. Explicit calculations are carried out for some cases (especially when the nebula can be considered a thin shell) for a temporary increase of continuum flux of simple "square-wave hump" shape. In some cases, changes in line intensities are predicted over times that are small compared with the light travel time across the nebula. The observational situation is described and further measurements are suggested for a number of objects that are relatively easy to study and whose further investigations seem likely to lead to important conclusions regarding the nebular parameters. These promising objects include QSOs, and N-type, Seyfert, and compact galaxies, as well as some x-ray sources and old novae. (auth)

15974 OPTICAL OBSERVATIONS OF SOUTHERN RADIO SOURCES. Burbidge, E. M.; Burbidge, G. R. (Univ. of California, San Diego). Astrophys. J.; 172: No. 1, 37-41(15 Feb 1972).

Spectrograms of a number of objects identified with southern radio sources were obtained with the 60-inch telescope of the Inter-American Observatory at Cerro Tololo, Chile. Redshifts were measured for 10 radio galaxies, and the spectroscopic features are listed. Direct photographs of some of the objects are described. Spectrograms of four stellar objects suggested as QSO identifications showed all objects to be galactic stars, including one recently suggested as an identification for PKS 1302 – 49 instead of NGC 4945. (auth)

15975 PULSAR ROTATION AND DISPERSION MEASURES AND THE GALACTIC MAGNETIC FIELD. Manchester, R. N. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J.; 172: No. 1, 43-52(15 Feb 1972).

Observations of pulsar polarization and pulse time of arrival at frequencies between 250 and 500 MHz were used to determine rotation and dispersion measures for 19 and 21 pulsars, respectively. These measurements were used to calculate mean line-of-sight components of the magnetic field in the path to the pulsars. These and other observations showed that there is probably no contribution to the observed rotation measure from the pulsar itself. Low-latitude, low-dispersion pulsars were observed to have strong field components, and a strong dependence of rotation-measure sign on galactic longitude was found. The observations were consistent with a relatively uniform field of about 3.5 microgauss directed toward about $l = 90°$ in the local region, but appear to be inconsistent with the helical model for the local field. (auth)

15976 MASSES OF TYPE II SUPERNOVA REMNANTS. Sofia, Sabatino (Univ. of South Florida, Tampa). Astrophys. J.; 172: No. 1, 53-55(15 Feb 1972).

It is shown that the mass ejected during a Type II supernova explosion in which a pulsar is formed is larger than 5 $M_\odot$, and may be as large as 40 $M_\odot$. (auth)

15977 HYPOTHESIS OF GRAVITATIONAL RADIATION OF A RAPIDLY ROTATING NEUTRON STAR. Tsygan, A. I. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 14: No. 8, 317-20(20 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 8, 465-8(20 Oct 1971).

It is assumed that rapidly rotating neutron stars can assume tesseral equilibrium shapes and should at the same time emit powerful pulses of gravitational radiation on going over from one tesseral shape to another. It is possible that J. Weber registered these pulses previously. The shapes of a rotating liquid most thoroughly investigated and known at present are: (a) oblate ellipsoid of revolution (the so-called Maclaurin ellipsoid), (b) tri-

axial ellipsoid (the Jacobi ellipsoid). The M and J ellipsoids have known regions of stability with respect to the angular momentum. At large values of the angular momentum of the liquid, other equilibrium shapes are also possible. The main assumption consists of: the tesseral equilibrium shapes constructed on the basis of the M ellipsoid are stable at sufficiently large deformation. Apparently there exist equilibrium shapes that are superpositions of different tesseral shapes, but no assumptions are made concerning their stability. The information is applied to a rotating neutron star during the first stages of its existence, when it can have the necessary angular momentum. Weber estimated the registered pulses of gravitational radiation, and, at weaker signals, a decrease of about one order of magnitude resulted. During the slowing-down process, the star with $M > 2.4M_{\odot}$ collapses, and at $M < 2.4M_{\odot}$ it turns into an ordinary pulsar. (J.C.W.)

15978 CONTEMPORARY STATUS OF X-RAY ASTRONOMY. Shklovskii, I. S. (Moscow State Univ.). Priroda; No. 9, 24-8(1971). (In Russian).

Various types of radiation identifiable from various cosmic sources are discussed. Various stars and nebulae are specified by name and evaluated as to the relative x-ray intensity observed on or near the Earth. (K.S.W.)

15979 BEAM-MASER MEASUREMENTS OF THE GROUND-STATE TRANSITION FREQUENCIES OF OH. Ter Meulen, J. J.; Dymanus, A. (Katholieke Univ., Nijmegen, Netherlands). Astrophys. J.; 172: No. 1, L21-3(15 Feb 1972).

Rest frequencies of the four transitions between the F = 2,1 hyperfine levels of the $^2\Pi_{\frac{1}{2}}$, $J = \frac{1}{2}$, Λ-doublet states of OH were determined with a beam-maser spectrometer. The frequencies are accurate to about 100 Hz, and the sum rule is satisfied to within about 100 Hz. (auth)

15980 PRELIMINARY OBSERVATIONS OF RADIO STAR SCINTILLATION AT GULMARG. Mattoo, S. K.; Bhonsle, R. V. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 601-4(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A Ryle-type two-element phase-switched interferometer operated at 74 MHz was built for the study of amplitude scintillations of radio waves coming from discrete radio sources, Cas A and Cyg A, during their passage through the ionosphere. The equipment has been in operation at Gulmarg since February 1970. A preliminary analysis of usable data has shown that the scintillation index attains a maximum value of 0.8. The maximum value of scintillation rate is found to be about 2.0 and a minimum value of 0.4 fades per minute. There is evidence that the scintillations could be associated with fluctuations in the total geomagnetic field. Both the regular and irregular amplitude scintillations were observed at Gulmarg. The regular amplitude scintillations during the observation period exhibited quasi-periodicity that varied between 30 and 220 sec. The appearance of the amplitude scintillations may depend on the relative contribution to the variation of amplitude by diffraction and refraction processes in the ionosphere. (auth)

15981 2700 MHz OBSERVATIONS OF 4C RADIO SOURCES IN THE DECLINATION ZONE $+4^0$ TO -4^0. Wall, J. V. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 20, 1-30(Dec 1971).

Most sources in the 4C catalogue with declinations between +4° and −4° were observed at 2700 MHz. Accurate positions, flux densities, and the results of a search for optical identifications are presented. A brief comparison is made with results from other investigations. (auth) (Australia)

15982 PARKES 2700 MHz SURVEY CATALOGUE FOR 03^h, 11^h, 19^h, AND 23^h ZONE, DECLINATIONS −33° TO −75°. Shimmins, A. J. (CSIRO, Epping, Australia). Aust. J. Phys. Astrophys. Suppl.; No. 21, 1-34(Dec 1971).

A catalog of 618 extragalactic radio sources obtained from a sky survey at 2700 MHz is presented. The area of 0.42 sr covers four southern zones of R.A. 03^h to 04^h, 11^h to 12^h, 19^h to 20^h, and 23^h to 00^h, between Dec. −33° and −75°, with a region omitted in the 11^h zone which is close to the galactic plane. The catalog is complete to a limiting flux density of 0.32 f.u. at 2700 MHz and is thought to be 90% complete at a flux density of 0.20 f.u. The positions are accurate to 15″ arc or slightly better in both coordinates for sources stronger than 0.32 f.u.; the flux densities of the weaker sources are accurate to 0.02 f.u., and for sources stronger than 1 f.u. the accuracy is 3%. (auth) (Australia)

15983 SOME IDENTIFICATIONS FOR WEAK SOURCES IN THE PARKES CATALOGUE FOR DECLINATIONS $+20^0$ TO -20^0. Bolton, J. G.; Wall, J. V.; Shimmins, A. J. (CSIRO, Epping, Australia). Aust. J. Phys.; 24: No. 6, 889-98(Dec 1971).

Accurate positions and flux densities at 2700 MHz were measured for 156 weak sources in the Parkes catalogue for declinations 0 to +20° and 0 to −20°. Identifications are suggested for 22 of the sources, 6 with galaxies and 16 with possible quasi-stellar objects. (auth)

15984 POLARIZATION OF EXTENDED RADIO SOURCES AT 6 CM WAVELENGTH. I. EXTRAGALACTIC SOURCES. Gardner, F. F.; Whiteoak, J. B. (CSIRO, Epping, Australia). Aust. J. Phys.; 24: No. 6, 899-911(Dec 1971).

Maps are presented of the linear polarization distributions over eight extragalactic radio sources. They were obtained at 6 cm wavelength with a 4′ arc resolution. Low brightness extensions show polarization of up to 70% with magnetic fields aligned perpendicular to their elongations. (auth) (Australia)

15985 POLARIZATION OF EXTENDED RADIO SOURCES AT 6 CM WAVELENGTH. II. GALACTIC SOURCES. Whiteoak, J. B.; Gardner, F. F. (CSIRO, Epping, Australia). Aust. J. Phys.; 24: No. 6, 913-24(Dec 1971).

Maps are presented of the polarization and total intensity distributions over the supernova remnants 13S6A, MSH 15 − 56, RCW 103, and W44. They were obtained at 6 cm wavelength with a 4′ arc resolution. It has not proved possible to interpret the polarization characteristics in terms of a simple expansion against the interstellar magnetoionic medium. (auth) (Australia)

15986 HYDROGEN-LINE INTENSITIES IN THE SPECTRUM OF AN OPTICALLY THICK PLASMA. Grinin, V. P. (Crimean Astrophysical Observatory, USSR). Astrophysics (Eng. Transl.); 5: No. 3, 172-7(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 371-81(1969).

The luminescence of a hydrogen plasma partially transparent in the Balmer lines is discussed for a recombinational mechanism of level population. The redistribution of radiation among the lines and within individual lines is taken into account. The relative intensities and equivalent widths of the Balmer lines are calculated for a number of electron temperatures and optical thicknesses in the H_α line. (auth)

15987 EVOLUTIONARY EFFECTS ASSOCIATED WITH QUASI-STELLAR RADIO SOURCES. I. Arakelyan, M. A. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Eng. Transl.); 5: No. 3, 226-36(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 461-76(1969).

The method of investigating evolutionary effects put forward by Schmidt (Astrophys. J., 151: 393(1968)) (the V/V_m method) for the sampling of quasi-stellar sources from the 3CR catalog was applied to two samples. In one case the volume V_m was calculated from the optical luminosity and, in the other, from the radio luminosity. In the former case, no evolutionary effects were established, whereas in the second there was no doubt about their presence. Similar results were obtained by investigating the quasi-stellar radio sources from the 4C catalog. These facts are interpreted as consequences of the uniform distribution of quasi-stellar radio sources in the surrounding space, their constant mean optical luminosity, and evolving radio luminosity. The variation in the mean radio luminosity can be understood in terms of the hypothesis in which quasi-stellar radio sources are regarded as an active phase of quasi-stellar objects. It is suggested that quasi-stellar objects occasionally undergo radio flares, and the intensity of these flares on the average decreases with time. (auth)

Solar Phenomena

Refer also to abstract 15939.

15988 (LA–4454(Vol.6)) VELA V AND VI SOLAR X-RAY ATLAS. VI. JANUARY 1 TO MAY 1, 1971. Blocker, N. K.; Chambers, W. H., Fehlau, P. E.; Fuller, J. C.; Kunz, W. E.; Milkey, R. W. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 123p. Dep. NTIS.

This report (Vol. VI) presents data obtained from the solar radiation monitors on the Vela VI Satellites. Equivalent graybody flux in three bands (0.3 to 3, 1 to 8, and 1 to 16Å) is plotted as a function of universal time, one day per page. Data from January 1 to May 1, 1971, are presented. (auth)

15989 DENSITY FLUCTUATIONS IN THE INTERPLANETARY PLASMA: AGREEMENT BETWEEN SPACE-PROBE AND RADIO SCATTERING OBSERVATIONS. Cronyn, Willard M. (National Oceanic and Atmospheric Adminstration, Boulder, Colo.). Astrophys. J.; 171: No. 3, L101-5(1 Feb 1972).

Measurements of interplanetary electron-density fluctuations, deduced from interplanetary scintillation spectra of compact radio sources, and measurements of interplanetary proton-density fluctuations made by space probes are in good agreement with a single, continuous power-law irregularity spectrum, index ~ −1.6 as measured by a space probe. The space-probe and radio-scattering observations give complementary information about plasma density variations over distances of from 6 to 6×10^5 km. (auth)

15990 DOMAINS OF EXISTENCE OF THE THREE TYPES OF SUPERSONIC SOLUTIONS OF THE INVISCID SOLAR-WIND EQUATIONS. Durney, B. R.; Werner, N. (National Center for Atmospheric Research, Boulder, Colo.). Astrophys. J.; 171: No. 3, 609-13(1 Feb 1972).

The approximate energy equation for radial distances larger than the critical point is solved with "critical point" boundary conditions. It is shown that if $\epsilon_\infty = (41/24)\ (12/5)^{\frac{1}{3}}\ (35/2A)^{\frac{1}{3}} = \epsilon_\infty^*$ (where ϵ_∞ is the residual energy per particle at infinity, $A = 5.8 \times 10^8/C$, and C is the mass flow) then the equation has the solution $T \propto r^{-\frac{1}{3}}$. If $\epsilon_\infty < \epsilon_\infty^*$, the asymptotic behavior of the temperature is $r^{-\frac{1}{3}}$; whereas if $\epsilon_\infty < \epsilon_\infty^*$, then $T \sim r^{-\frac{1}{3}}$ for large values of r. This clarifies the domains of existence of the Parker, Whang and Chang, and $r^{-\frac{1}{3}}$ supersonic solutions of the solar-wind equations. (auth)

15991 IDENTIFICATION OF $^{13}C^{16}O$ IN THE INFRARED SUNSPOT SPECTRUM AND THE DETERMINATION OF THE SOLAR $^{12}C/^{13}C$ ABUNDANCE RATIO. Hall, Donald N. B. (Kitt Peak National Observatory, Tucson, Ariz.); Noyes, Robert W.; Ayres, Thomas R. Astrophys. J.; 171: No. 3, 615-20(1 Feb 1972).

The presence of the first-overtone vibration–rotation bands of $^{13}C^{16}O$ in the infrared sunspot spectrum was established on the basis of wavenumber and relative intensity consistency of 30 weak lines. Nine particularly clean lines were used to obtain a solar $^{12}C/^{13}C$ abundance ratio of 90 with a probable error of 15%. (auth)

15992 VACUUM-ULTRAVIOLET SPECTRUM OF NEUTRAL BORON. Goorvitch, David; Valero, Francisco P. J. (Ames Research Center, Moffett Field, Calif.). Astrophys. J.; 171: No. 3, 643-5(1 Feb 1972).

A hollow-cathode light source was used to produce the vacuum-ultraviolet spectrum of B I. The $2s^22p^2P^0 - 2s2p^2\ ^2P$ transition was resolved and the $2s^22p^2P^0 - 2s^2nd^2D$ (n = 3–7), $2s^22p^2P^0 - 2s^2ns^2S$ (n = 3–5), the $2s2p^2\ ^4P - 2p^3\ ^4S^0$, and the $2s^22p^2P^0 - 2s2p^2\ ^2S$ transitions were measured. A revised value for the $2s2p^2\ ^2P$ term resulted from these measurements. (auth)

15993 OVERLAP OF ARGON ION SPECTRA WITH SATELLITES TO THE LYMAN-ALPHA LINES OF CARBON AND BORON. Jalufka, N. W. (Langley Research Center, Hampton, Va.); Cooper, J. Astrophys. J.; 171: No. 3, 647-9(1 Feb 1972).

A theta pinch was employed to investigate satellites to the H-like and He-like ion resonance lines of boron and carbon. Identification of the spectra showed an overlap of the Ar IX, Ar XI, and Ar XII lines with the predicted satellite wavelengths, and it was concluded that many of the previously reported satellite lines are due to argon impurities. (auth)

15994 OBSERVATION OF THE GREEN LINE WITH AN ELECTRONIC CAMERA DURING THE ECLIPSE OF MARCH 7, 1970. Fort, B.; Picat, J. P.; Combes, M.; Felenbok, P. (Observatoire, Meudon, France). Astron. Astrophys.; 17: No. 1, 55-9(Feb 1972).

The west part of the solar corona was studied using an electrostatic camera derived from the Lallemand type. Results given are the brightness measured in the 5,303 Å line and in the neighboring continuum up to $\rho = 1.7\ R_\odot$ from the center of the Sun. The electron density and mean temperature derived from the ionization degree are given for a real height h in the condensation and above the surface of the Sun from $0.2\ R_\odot$ to $0.9\ R_\odot$. The ion abundance is found equal to $7.6\ 10^{-5}$. (auth)

15995 BLOCKING EFFECT OF LINES ON SOLAR UV CONTINUUM BETWEEN 2000 AND 3000 A. Sacotte, D.; Bonnet, R. M. (CNRS, Verrieres-le-Boisson, France). Astron. Astrophys.; 17: No. 1, 60-9(Feb 1972).

A synthetic solar spectrum using 2400 lines was computed for the near uv region of 2000 to 3000 Å and compared with the observations. The Bilderberg Continuum Atmosphere and the Holweger model were used. The results were similar with both models. The introduction of absorption lines did not lead to a good agreement with observations. For the extra opacity two components were found: a "disturbed" component and a linear one. It is shown that the evaluation of the damping constants is highly open to criticism, leading one to attribute the "disturbed" component to wide metallic lines. It is suggested that the linear component might be attributed to a great number of weak lines, and an attempt was made to evaluate their number. (auth)

15996 LIFETIME MEASUREMENTS OF OPTICAL LEVELS OF Ni I. Marek, Jan (Univ., Kiel). Astron. Astrophys.; 17: No. 1, 83-7(Feb 1972). (In German).

Using the phase-shift method, the mean lifetimes of some Ni I levels were determined. The results were: $z^3P_1^0$: 9.72, $z^3P_2^0$: 9.91, $z^3F_3^0$: 12.26, $z^5F_1^0$: 16.85, and $z^5F_2^0$: 33.4 ns. By variation of experimental parameters it was possible to depress the errors to a few percent. Relative transition probabilities of all lines depopulating the investigated levels have been measured by a number of authors. Thus, the absolute transition probabilities of the strongest transitions were derived. Some of the values were compared with the results of absorption experiments by Lawrence, Link, and King (1965). The agreement was good. (auth)

15997 THIN SOLAR CONVECTION ZONE AND SUNSPOTS. Mullan, D. J. (Armagh Observatory, Ireland). Nature (London) Phys. Sci.; 235: No. 55, 58-9(17 Jan 1972).

It is stated that there is a coincidence between the depth of a sunspot and recent determinations of the depth of the solar convection zone. Data from sunspots appear to be consistent with a shallow solar convection zone, an order of magnitude thinner than hitherto accepted models would suggest, and it is suggested that the boundary condition to be applied at the base of a sunspot when constructing a sunspot model is that the depth of the spot should be set equal to, or less than, the depth of the convection zone. Large spots would then have the natural boundary condition that their depth must be 10,400 km. (UK)

15998 ABSORPTION SPECTRUM OF Tl I IN THE VACUUM ULTRAVIOLET. Connerade, J. P. (Imperial Coll. of Science and Tech., London. ESRIN, Rome). Astrophys. J.; 172: No. 1, 213-27(15 Feb 1972).

The absorption spectrum of Tl I vapor was observed in the vacuum-ultraviolet, and a large number of new transitions was found. An analysis and a comparison with recent work on similar spectra are given. (auth)

15999 RATIO OF LINE INTENSITIES IN HELIUM-LIKE IONS AS A DENSITY INDICATOR. Blumenthal, George R. (American Science and Engineering, Cambridge, Mass.); Drake, G. W. F.; Tucker, Wallace H. Astrophys. J.; 172: No. 1, 205-12(15 Feb 1972).

The ratio R of the forbidden- to intercombination-line intensities in helium-like ions was evaluated as a function of temperature. The effects of cascades to the n = 2 levels following recombination and collisional excitation of higher levels were considered. Both the temperature variation and the effect of cascades are important for an accurate determination of R. The use of R as a density indicator in solar-active regions and flares is discussed, and the theoretical results are compared with observations. In thermal cosmic x-ray sources this method may give information on the electron density in the source or on the ultraviolet flux in the vicinity of the hot plasma. (auth)

16000 FILAMENTARY STRUCTURE OF THE SOLAR MAGNETIC FIELD. DATA FROM THE THIRD FLIGHT OF THE SOVIET STRATOSPHERIC OBSERVATORY. Krat, V. A. Vestn. Akad. Nauk SSSR; No. 12, 28-33(Dec 1971). (In Russian).

The structure of the solar disc, evidenced in photographs showing granulation near the center, and the special character of many large sunspots are considered. Some of these phenomena are explained by convective movement of the Sun's layers. Magnetic lines of forces may be bunched in such a way as to relate to the surface structure. (K.S.W.)

16001 PLASMA PHYSICS, SPACE RESEARCH, AND THE ORIGIN OF THE SOLAR SYSTEM. Alfven, Hannes (Kungliga Tekniska Hoegskolan, Stockholm). pp 149-57 of Nobel Prizes 1970. /Odelberg, W. (ed.). Stockholm; Norstedt (1971).

Certain aims of space research and the state of plasma physics are summarized. Discussions of two approaches to cosmic plasma physics and the general character of a theory on the origin and evolution of the solar system are presented. It is pointed out that the knowledge of plasmas is fundamental to an understanding of the origin and evolution of the solar system. There are good reasons to believe that the matter which now forms the celestial bodies once was dispersed in a plasma state. It is emphasized that astrophysics essentially must be an application to cosmic phenomena of the laws of nature found in the laboratory. (G.N.) (Sweden)

16002 X-RAY EMISSION OF THE ACTIVE CENTERS ON THE SOLAR DISK. Mergentaler, J.; Kordylewski, Z.; Hlond,

M. (Univ., Wroclaw. Astronomical Inst., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 19: No. 11, 1065-7(1971).

In order to investigate the distribution of x-ray radiation on the solar disc, a battery of pinhole cameras was mounted on the geophysical rocket Vertical I made available to Wroclaw heliophysicists by Soviet scientists in the project "Intercosmos." The rocket was launched on November 28, 1970, at 8 h 30 min UT and reached a ceiling of 487 km. The photographs of eight distinct active regions were obtained and correlated with groups of sunspots. The relatively strong flux obtained through the beryllium filter, not very different from the flux through the aluminum filter, suggests the temperature to be somewhat higher than 2×10^6°K. (auth)

16003 HELIUM AND HEAVY IONS IN THE SOLAR WIND. Formisano, V. (CNR, Rome. Univ., Rome); Moreno, G. Riv. Nuovo Cim.; 1: No. 3, 365-422(Jul-Sep 1971).

The behavior of helium and heavier ions through the expanding solar corona and in the solar wind is discussed. The relative abundance of these elements observed in the solar wind is compared with the solar abundances as known from direct observations and from theoretical predictions. The problem of solar-atmosphere composition is discussed. A review is given of the theoretical models of the expanding solar corona containing an analysis of the behavior of helium and other heavy ions. Some direct observations are discussed. (M.O.W.)

16004 SOLAR OBSERVATIONS MADE AT CATANIA ASTROPHYSICAL OBSERVATORY DURING 1970. Osservatorio Astrofisico di Catania, Publication No. 148. Rome; Consiglio Nazionale delle Ricerche (1971). 176p.

Observations were regularly made of the photosphere, Hα chromosphere on disc, Hα chromosphere at limb, K chromosphere at limb, K chromosphere on disc, and special events. (W.D.M.)

16005 LARGE-SCALE MOTIONS IN THE SUN. Piddington, J. H. (CSIRO, Sydney). Solar Phys.; 21: No. 1, 4-20 (Dec 1971).

Large-scale solar motions comprise differential rotation (with latitudinal, and perhaps radial gradients), axially symmetric meridional motions, and possible asymmetric motions (giant convective cells or Rossby-type waves or both). These motions must be basic in any satisfactory theory of the changing pattern of solar magnetic fields and of the 22-yr cycle. In the present paper available data are discussed and, as far as possible, evaluated and explained. Rotational measurements are based on the changing positions of discrete features such as sunspots, on Doppler shifts, on geophysical changes and on statistical evaluation of the motions of diffuse objects. The first mentioned, comprising faculae, sunspots, K-corona (to latitudes ~45°) and filaments, show agreement better than 0.7%. A new formula for surface rotation ω_s, based on faculae and sunspot data, is $\omega_s = 14.52 - 2.48 \sin^2 b - 2.51 \sin^4 b$ deg day^{-1}, where b is latitude, and validity may extend to about 70°. Errors in Doppler shift measurements and statistical treatments are discussed. There is evidence of a much slower coronal rate at high latitudes, and of a slower sub-surface rate at lower latitudes. Ordered meridional motions were revealed by statistical investigations of the positions of spot groups, of spots and of filaments. All these results seem explicable in terms of an oscillating hydromagnetic circulation in each hemisphere. These have both 11-yr and 22-yr components, and these periods are provided by a general dipole field of about one gauss, together with a pair of toroidal fields centered at latitudes ±16° and of average strength of order 10 G. Evidence of large-scale (perhaps 3×10^5 km), irregular surface motions is provided by the distribution of surface magnetic flux, the motions of sunspots, and Doppler-shift observations; it is supported by Ward's theory of the equatorial acceleration. The possibility is suggested that these asymmetric motions also drive the oscillatory meridional motions. (auth)

16006 SOLAR OBLATENESS: THE COMBINED EFFECT OF A POLE-EQUATOR DIFFERENCE IN EFFECTIVE TEMPERATURE AND MECHANICAL HEATING. Durney, B. R.; Werner, N. E. (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys.; 21: No. 1, 21-6(Dec 1971).

With the help of a model atmosphere of the Sun the pole–equator difference in flux (as measured by Dicke and Goldenberg) was evaluated assuming the following type of pole–equator temperature difference ($\Delta T = T_e - T_p$): (a) $\Delta T \approx 2$K for $\tau > \tau_0 (\tau_0 \approx 0.05)$; (b) $\Delta T \approx 10$K for $\tau < \tau_0$. The small ΔT at all optical depths given by (a) could, for example, be due to a pole–equator difference in effective temperatures. At small optical depths a difference in mechanical heating could give rise to the larger temperature difference given by (b). Results of the calculations were compared with Dicke and Goldenberg's observations. (auth)

16007 ULTRAVIOLET SOLAR SPECTRUM RECORDED BY ECHELLE SPECTROGRAPH (1970 TO 1800 A). McAllister, Howard C. (Univ. of Hawaii, Honolulu). Solar Phys.; 21: No. 1, 27-37(Dec 1971).

Six spectrograms of the solar spectrum were obtained in the region from 1970 to 1800 Å at a resolution of approximately 2×10^5 with a rocket-borne spectrograph using an echelle as the principal dispersing element. Reduction of data obtained was completed in the region from 1946.5 to 1963.5 Å, in which 79 absorption features were measured and 33 identified. Most of the identified stronger lines were due to Fe I. A significant feature of the solar spectrum in this region coincided with the raie ultime of Se I. (auth)

16008 ISOELECTRONIC WAVELENGTH CALCULATIONS FOR ARGON SPECTRA. Williams, M. D. (Langley Research Center, Hampton, Va.). Solar Phys.; 21: No. 1, 38-9(Dec 1971).

Tentative identifications are given for the lines at 36.52, 36.74, and 39.93 Å, which Connerade et al. listed as unidentified. (W.D.M.)

16009 ACCURACY OF HARTREE–FOCK THEORETICAL WAVELENGTHS IN THE XUV. Connerade, J. P. (European Space Research Inst., Frascati, Italy). Solar Phys.; 21: No. 1, 40-1(Dec 1971).

The program of Froese-Fischer (Computer Phys. Comm., 1: 151(1969)), was used to compute parameters for the $2p^6\ {}^1S_0$ and $2p^5$ 4s configurations in the sequence Al IV–Ca XI. (W.D.M.)

16010 MULTI-CHANNEL MAGNETOGRAPH OBSERVATIONS. III. FACULAE. Frazier, Edward N. (Aerospace Corp., El Segundo, Calif.). Solar Phys.; 21: No. 1, 42-53(Dec 1971).

Simultaneous observations of photospheric magnetic fields, Ca II K emission, the "photospheric network," and continuum faculae show that these four quantities are correlated in a complicated manner. The photospheric and calcium networks show increasing contrast with increasing magnetic field strength up to field strengths of about 500 G. Higher values of the magnetic field are found only in pores and sunspots. Continuum faculae also show increasing contrast with increasing magnetic field strength (even at the disk center), but this contrast reaches a maximum at field strengths of about 200 G. At higher field strengths, continuum faculae become monotonically darker until pore or spunspot conditions are reached. Measurements of the photospheric network and the continuum faculae over a wide range of μ result in families of limb contrast curves. These curves indicate that the dependence on H is as important as the dependence on μ. They also indicate that the magnetic field has a preferred inclination of about 50°. The facular contrast shows little dependence on resolution. This is interpreted in terms of a geometric model in which faculae are clumps of many individual flux tubes. These tubes are closely packed and unresolvable in the photosphere, but are more widely spaced, and therefore resolvable, in the low chromosphere. (auth)

16011 OBSERVATION ON THE DETAILED CORRESPONDENCE OF MAGNETIC AND Hα FEATURES. Schoolman, Stephen A. (California Inst. of Tech., Pasadena). Solar Phys.; 21: No. 1, 57-9(Dec 1971).

Observations obtained at the Big Bear Solar Observatory on March 21, 1971 are discussed. The telescope was pointed at an area on the west side of the disk which showed no significant Hα plages, and a series of video magnetograms was taken. An Hα wavelength scan using a one-half angström Halle filter was also taken. (W.D.M.)

16012 COMPARISON BETWEEN MgII AND CaII SPECTROHELIOGRAMS. Fredga, Kerstin (Sonnenburg Observatory, Utrecht. Stockholm Observatory, Saltsjoebaden, Sweden). Solar Phys.; 21: No. 1, 60-81(Dec 1971).

A detailed photometric comparison between a Mg II K filter-heliogram and a nearly simultaneous Ca II K spectroheliogram is presented. The comparison shows a close correspondence in both location and intensity of the bright features on the Sun with a correlation coefficient of 0.92 ± 0.02 between the Mg II and the Ca II intensities in active regions. A small flare is most likely observed in the Mg II heliogram giving a substantial contribution to the recorded intensity. The heights in the solar atmosphere at which the Mg II K and Ca II K lines are formed were estimated. Taking into account the general shape of the line profiles and the different passbands used in the recordings an average height of formation of 1700 to 1900 km above the photosphere for these particular heliograms was obtained. (auth)

16013 EFFECT OF TWO-DIMENSIONAL MACROSCOPIC VELOCITY FIELDS ON MODELS OF THE LOWER SOLAR CHROMOSPHERE. Cannon, C. J. (Univ. of Sydney). Solar Phys.; 21: No. 1, 82-92(Dec 1971).

Two- dimensional macroscopic velocity fields are featured in the calculation of two-dimensional models of the lower solar chromosphere. Relative rms line center intensity fluctuation data and mean limb-darkening data obtained in Mg b and Na D were used together with values of the cross-correlation between line center brightness and "line of sight velocities." It was found that the large scale fluctuation data can be explained by models of the lower solar chromosphere in which the inhomogeneous effects arise only from horizontal, two-dimensional macroscopic velocity fields. It is shown, however, that the corresponding small scale fluctuation data cannot be explained in a similar manner. The cross-correlation data was found to be a powerful constraint in the computation of two-dimensional models of these regions. (auth)

16014 INTENSITY DISTRIBUTION OF BRIGHT POINTS OBSERVED ON A CN SPECTROHELIOGRAM. Gillespie, Bruce (Univ. of Michigan, Ann Arbor. Kitt Peak National Observatory, Tucson Ariz.). Solar Phys.; 21: No. 1, 93-5(Dec 1971).

Intimate spatial and quantitative relations have recently been noted between the photospheric network as observed in temperature-sensitive lines and the local magnetic fields. A report is given of photometry of bright photospheric network points observed on a spectroheliogram taken under optimal seeing conditions. (W.D.M.)

16015 INFLUENCE OF THE SUNSPOT MODEL OF THE Li ABUNDANCE. Stellmacher, G. (Institut d'Astrophysique, Paris); Wiehr, E. Solar Phys.; 21: No. 1, 96-100(Dec 1971).

The dependence of the Li abundance on the equivalent width of the Li-resonance doublet at λ 6708 Å is calculated for different umbral models. The choice of the model strongly influences the deduced Li abundance (up to a factor 8 or $\Delta \log \epsilon_{Li} = 0.9$) even when using recent umbral models. Detailed discussion of the observations and reduction with the most suitable umbral model (Stellmacher and Wiehr, 1970) leads to an abundance of $\log \epsilon_{Li} = 1.1 \pm 0.05$ (in the $\log \epsilon_H = 12.0$ scale). (auth)

16016 FACULAR MODELS AND THE SUNSPOT ENERGY DEFICIT. Wilson, P. R. (Univ. of Sydney). Solar Phys.; 21: No. 1, 101-112(Dec 1971).

The problem of the energy deficit in a sunspot is shown to be critically related to the depth of a given sunspot model. Recent facular models are discussed and a new model is derived from recent data, using a two-dimensional radiative-transfer analysis. The excess nonradiative energy required by this and other models is evaluated, and it is shown that in some models this may account for a considerable fraction of the sunspot energy deficit. For these models the Alfvén energy traveling along the closed flux loops from the sunspot is insufficient to supply the requirements of the faculae, and it is suggested that excess energy flux from below the faculae is also required. These results provide further support for "deep" as opposed to "shallow" sunspot models. (auth)

16017 OBSERVATION OF FILAMENTARY STRUCTURE IN SUNSPOT UMBRAE. Papathanasoglou, D. (Univ. of Athens). Solar Phys.; 21: No. 1, 113-15(Dec 1971).

On the prints of two excellent-quality negatives, it was observed that the bright penumbral filaments penetrate deeply into the umbra and many of them cross the umbra "joining" with a filament on the opposite side of the penumbra. Moreover the filaments of different direction "cross" each other and form a bright network over the dark umbra, while the crossing points look like bright dots, because of the addition of the light of the crossing filaments. (W.D.M.)

16018 d-c ELECTRICAL CONDUCTIVITY IN A PARTIALLY IONIZED SOLAR MAGNETOPLASMA. Wyller, Arne A.; Hong Sik Yun (Franklin Inst., Swarthmore, Pa.). Solar Phys.; 21: No. 1, 116-20(Dec 1971).

A numerical application to the extreme cases of high and low degree of ionization of the binary collision theory of Burgers (1960) and the multiple collision theory of Shkarofsky (1960) shows very good agreement in the values of the magnetic tensor components for solar electrical conductivity. It is pointed out that the inclusion of ion motions in Burgers theory favors its use in the future evaluation of the solar thermal conductivity tensor. (auth)

16019 METHOD FOR THE EVALUATION OF THE BRIGHTNESS DISTRIBUTION IN THE SOLAR CORONA. Stanek, W. (Eidgenoessische Sternwarte, Zurich). Solar Phys.; 21: No. 1, 121-9(Dec 1971).

With photography of the solar corona at eclipses as an example a method is given to calculate the relative brightnesses along a solar radius from a set of photographs. This set must be taken with different exposures, the ratio of two successive exposures, however, being constant. From the photometry of the density the relative brightnesses can be derived by a procedure consisting of three steps: (1) Reconstruction of a different characteristic curve; (2) Compensation of the whole set of photographs; this leads to a discrete number of density values to be associated with the relative brightnesses of the corona. For an arbitrary density value: (3) an improved method of interpolation based on the least-square method is required. The procedure can more easily be carried out by computer analysis. (auth)

16020 SOLAR RADIO EMISSION AT 1.2 mm WAVELENGTH. Kundu, M. R. (Univ. of Maryland, College Park). Solar Phys.; 21: No. 1, 130-6(Dec 1971).

Some properties of solar active regions at 1.2 mm wavelength are discussed. Equatorial and polar brightness distributions of the quiet Sun at 1.2 mm wavelength are also presented. (auth)

16021 CHROMOSPHERIC ABSORBING FEATURES PROMISING THE APPEARANCE AND THE DEVELOPMENT OF AN ACTIVE CENTER. Martres, M.-J.; Soru-Escaut, I. (Observatoire, Paris). Solar Phys.; 21: No. 1, 137-45(Dec 1971).

Some absorbing features seldom associated with flare occurrence and observed in the wings of Hα by means of a cinematographic patrol were studied. Short-lived chromospheric dark features with strong velocity fields are described and their correlation with the birth and the further development of an active center is shown. It is shown that radial velocities precede the modifications of magnetic fields. An attempt to compare these chromospheric velocities and photospheric ones points out that it could be possible to find good correlation between them in a changing but not-flaring region. (auth)

16022 SOFT SOLAR X RAYS AND SOLAR ACTIVITY. VI. OPTICAL IDENTIFICATION OF ACTIVITY ASSOCIATED WITH X-RAY BACKGROUND FLUCTUATIONS. Teske, Richard G. (Univ. of Michigan, Ann Arbor). Solar Phys.; 21: No. 1, 146-56(Dec 1971).

Minor Hα activity, consisting of small brightenings and small, surgelike spikes, was observed to take place above an active center at the solar limb in good time-association with small fluctuations in the soft x-ray background flux, suggesting that even small dynamical events seen optically are associated with coronal heating. The ratio of Hα flux to soft x-ray flux in some of the surges was approximately the same as the ratio already established for flares. The total energy dissipated by the events in a 24-hour period is estimated; it is approximately equivalent to that released by one flare of importance 1 per day. (auth)

16023 MAGNETICALLY TRAPPED PARTICLES IN THE LOWER SOLAR ATMOSPHERE. Benz, A. O.; Gold, T. (Cornell Univ., Ithaca, N. Y.). Solar Phys.; 21: No. 1, 157-66(Dec 1971).

The trapping of energetic electrons and protons in a simple, arched magnetic field imbedded in the lower solar atmosphere was considered. The lifetime of electrons with kinetic energies up to about 1.5 MeV was found to be completely determined by the motion of the mirror points, provided the gyro-synchrotron loss can be neglected. The same motion also influences the lifetimes of more energetic electrons, up to 10 MeV. This was not found to be the case for protons in the range from 1 MeV to 100 GeV. Some fluid and streaming instabilities were also considered; they pull the particles upward, raise their mirror points, and increase their lifetime. The emission of gyro-synchrotron radiation and bremsstrahlung in this model was related to observations. Using the duration of nonthermal x-ray peaks given by Kane (1969), the altitude of injection of energetic particles was estimated. (auth)

16024 SOLAR FLARES IN THE EXTREME ULTRAVIOLET. Hall, L. A. (Air Force Cambridge Research Labs., Bedford, Mass.). Solar Phys.; 21: No. 1, 167-75(Dec 1971).

Measurements of flare-related impulsive enchancements in solar emission lines in the extreme ultraviolet, observed from the satellite OSO-III, are reported. The enhancement of a line, expressed in percent of the total disk intensity in the line, is of the same order of magnitude as the flare area, expressed in heliocentric square degrees. Rise times and decay times of impulsive enhancements average about 2 min and 5 min, respectively. The maximum enhancements of radiation from ions in the chromosphere–corona transition region precede the Hα maximum by an average of 2 min, and occur in the same period of time as the hard component of solar x rays and the impulsive microwave bursts. Coronal lines in the extreme ultraviolet are less impulsive than the transition-region lines in flare-related enhancements, and their maxima follow the Hα maximum. (auth)

16025 TRANSFER OF LYMAN CONTINUUM RADIATION IN CHROMOSPHERIC FLARES. Kandel, Robert S.; Papagiannis, Michael D.; Strauss, Federico M. (Boston Univ.). Solar Phys.; 21: No. 1, 176-87(Dec 1971).

The time evolution of a layer of the middle or lower chromosphere being heated by a stream of energetic particles during a solar flare was studied. The region, which is not in LTE, was allowed to cool by the transfer of Lyman continuum radiation, with collisional as well as radiative processes being considered. The resulting time dependence of the electron density and the effective thickness of the layer were in good agreement with values derived from observations. The supply of energetic particles was assumed to be cut off when the central electron density of the model layer reached the peak value of $n_e = 4.4 \times 10^{13}$ cm^{-3} derived from observations of an importance 3 flare. Depending on the total hydrogen density assumed, the central electron temperature reached a value ranging from 8,000 to 10,000 K. These quantities decreased by 20% during the following minute and at a slower rate thereafter. (auth)

16026 ELECTRON TEMPERATURE AND EMISSION MEASURE VARIATIONS DURING SOLAR X-RAY FLARES. Horan, D. M. (Naval Research Lab., Washington, D. C.). Solar Phys.; 21: No. 1, 188-97(Dec 1971).

X-ray emission from seventeen x-ray flares was analyzed to obtain electron temperatures and emission measures associated with the source region in the solar corona. The source region was assumed to be isothermal with a Maxwellian electron velocity distribution. Flares which were characterized by a rapid initial x-ray flux increase were found to also have a rapid initial rise in electron temperature and emission measure. Flares which were characterized by a gradual initial x-ray energy flux increase were found to have a less rapid initial rise in electron temperature and emission measure. In all x-ray flares studied the peak temperature chronologically preceded the peak x-ray flux and the peak flux never came after the peak emission measure. (auth)

16027 COMPARISON OF TYPE III SOLAR RADIO BURST THEORIES USING SATELLITE RADIO OBSERVATIONS AND PARTICLE MEASUREMENTS. Evans, Larry G.; Fainberg, Joseph; Stone, R. G. (Goddard Space Flight Center, Greenbelt, Md.). Solar Phys.; 21: No. 1, 198-203(Dec 1971).

The required electron density to excite a Type III solar burst can be predicted from different theories, using the low-frequency observations of the RAE-1 satellite. Electron flux measurements by satellite in the vicinity of 1 AU then give an independent means of comparing these predicted exciter electron densities to the measured density. On this basis, one theory predicts the electron density in closest agreement with the measured values. (auth)

16028 LOW-ENERGY PROTON INCREASES ASSOCIATED WITH INTERPLANETARY SHOCK WAVES. Palmeira, R. A. R. Univ. of Texas, Dallas); Allum, F. R.; Rao, U. R. Solar Phys.; 21: No. 1, 204-24(Dec 1971).

Impulsive increases in the low-energy proton flux observed by the Explorer 34 satellite, in very close time association with geomagnetic storm sudden commencements, are described. It is shown that these events are of short duration (20 to 30 min) and occur only during the decay phase of a solar cosmic-ray flare event. The differential energy spectrum and the angular distribution of the direction of arrival of the particles are discussed. Two similar increases observed far away from the Earth by the Pioneer 7 and 8 deep-space probes are also presented. These impulsive increases are compared with energetic storm particle events and their similarities and differences are discussed. A model is suggested to explain these increases, based on the sweeping and trapping of low-energy cosmic rays of solar origin by the advancing shock front responsible for the sudden commencement detected on the Earth. (auth)

16029 NONRADIAL OSCILLATIONS AND ENERGY TRANSPORT IN ROTATING SOLAR (STELLAR) WIND. Grzedzielski, S. (Manchester Univ., Eng. Univ., Warsaw). Solar Phys.; 21: No. 1, 225-36(Dec 1971).

The propagation of nonradial, small amplitude perturbations superposed on a zero-order, stationary, nonmagnetic, polytropic, rotating stellar wind is studied in the limit of the "local" theory, i.e., for $\kappa r \gg 1$, κ being the module of the wave vector and r the characteristic scale of the zero-order flow. The resulting dispersion equation is of the 3rd order in (complex) frequency and the possible modes correspond to two acoustic-type waves, and to a gravity-shear wave with strongly anisotropic propagation properties, due to coupling between the internal gravity waves and shear motion. The gravity-shear mode allows velocity differences in the medium to exist with no corresponding density fluctuations and hence with no shock-wave formation. It is suggested that this mode corresponds to some of the fast–slow velocity streams observed in the interplanetary medium and may provide means for wave energy being transported outwards with the zero-order flow, with little dissipation in the inner region of the solar wind. (auth)

16030 ELIMINATION OF SEEING EFFECTS FROM SOLAR INTENSITY MEASUREMENTS. Wittmann, A. (Univ., Goettingen, Ger.). Solar Phys.; 21: No. 1, 237-9(Dec 1971).

A method of solving the convolution integral is provided by the method of successive smoothing. A brief description of the method is given, and attention is drawn to its usefulness for the correction of intensity measurements of sunspots, pores, filaments, etc. (W.D.M.)

16031 PROBABLE BEHAVIOR OF SUNSPOT CYCLE 21. Gleissberg, W. (Univ., Frankfurt am Main). Solar Phys.; 21: No. 1, 240-5(Dec 1971).

After an explanation of the method of forecasting based upon the 80-yr sunspot cycle, reasons are given for assuming that the maximum of the present 80-yr cycle now has passed. Starting from this assumption the following predictions can be made: (1) Cycle 21 will be so weak that the highest value of the smoothed monthly means of the sunspot-relative-numbers will lie between 56 and 96; (2) the minimum at the beginning of Cycle 21 will occur during the first half of 1975; (3) Cycle 21 will attain its maximum between 1979.5 and 1980.5; and (4) the minimum terminating Cycle 21 will take place during the first half of 1986. A comparison with other predictions shows that they differ considerably from one another; nevertheless, several of them yield results similar to the predictions stated here. (auth)

16032 NEW REPRESENTATION OF THE 80-YEAR CYCLE IN SUNSPOT FREQUENCY. Hartmann,Renate (Univ., Frankfurt am Main). Solar Phys.; 21: No. 1, 246-8(Dec 1971).

An attempt is made to deduce the 80-year sunspot cycle from the yearly means $\bar{R}$ of the sunspot relative numbers immediately without using any kind of averaging or smoothing. (W.D.M.)

Galaxies

16033 CASE FOR CORRELATED OPTICAL AND RADIO VARIABILITY OF THE SEYFERT GALAXY 3C 120. Usher, Peter D. (Pennsylvania State Univ., University Park). Astrophys. J.; 172: No. 1, L25-7(15 Feb 1972).

The first evidence for correlated optical and radio variability in compact galaxies is presented for the Seyfert galaxy 3C 120. The history of the optical variability of 3C 120 suggests that the occurrence of an optical event at epoch 1967.5 ± 0.25 is the precursor to the radio Event II documented by Pauliny-Toth and Kellermann. Delay times for radio variability following optical variability are predicted. (auth)

16034 PARKES SURVEY OF 21-CENTIMETER ABSORPTION IN DISCRETE-SOURCE SPECTRA. II. GALACTIC 21-CENTIMETER OBSERVATIONS IN THE DIRECTION OF 35 EXTRAGALACTIC SOURCES. Radhakrishnan, V.; Murray, J. D.; Lockhart, Peggy; Whittle, R. P. J. (CSIRO, Sydney). Astrophys. J., Suppl. Ser.; 24: No. 203, 15-47(Jan 1972).

A detailed comparison of emission and absorption spectra obtained in the direction of extragalactic sources permits an unambiguous separation of the contribution from a diffuse, high-temperature, optically thin component and that from denser and colder local concentrations of hydrogen. The concentrations have a mean column density $N_{H_e} \approx 3 \times 10^{20}$ atoms cm^{-2} and a spin temperature $T_s \approx 60°$ to 80° K. They are typically separated along a line of sight by one full scale-thickness of the galactic disk. The diffuse intercloud medium has a column density $N_{HI} \approx 1.4 \times 10^{20}$ cosec |b| atoms cm^{-2}, a spin temperature in excess of 750°K, and contains half of the total mass of hydrogen in the solar neighborhood. (auth)

16035 SPECTRA OF TWO GALAXIES NEAR PKS 2251 +11. Robinson, L. B.; Wampler, E. J. (Univ. of California, Santa Cruz). Astrophys. J.; 171: No. 3, L83-6(1 Feb 1972).

Redshifts for two galaxies in the group associated with the quasi-stellar source PKS 2251 + 11 were determined from the measurements of the H and K absorption lines of Ca II. The measured redshift of the brighter galaxy is within 60 km s^{-1} of the redshift of the quasi-stellar source. The other differs by 1000 km s^{-1}. Strong hydrogen-line emission reported earlier for the brighter galaxy was not detected. (auth)

16036 PHOTOMETRY OF COMPACT GALAXIES. Shen, B. S. P. (Univ. of Pennsylvania, Philadelphia); Usher, P. D.; Barrett, J. W. Astrophys. J.; 171: No. 3, 457-61(1 Feb 1972).

Photometric histories of the N galaxies 3C 390.3 and PKS 0521 – 36 were determined from plates of the Harvard collection. Four other compact galaxies (Markarian 9, I Zw 92, II Zw 136, III Zw 77) showed no evidence of historical variability beyond the uncertainties of the photometry. (auth)

16037 COLOR CHANGE OF A POPULATION MODEL BASED ON THE M32 GALAXY OVER THE FOUR-BILLION-YEAR LOOK-BACK TIME TO 3C 295. Spinrad, Hyron (Univ. of California, Berkeley). Astrophys. J.; 171: No. 3, 463-6(1 Feb 1972).

The systematic change with age of the stellar content of the Spinrad–Taylor M32 model is used to simulate the change in the color of the integrated light of a giant E galaxy over the look-back time of 4×10^9 y, appropriate for the distant radio galaxy 3C 295. M32 is bluer than nearby gE galaxy centers, but very similar to their integral colors. It is a more appropriate system to use for evolutionary correction computations than the M31 nucleus or the M31 disk model of Tinsley and Spinrad. The evolutionary change in a color index like B – V is expected to be small; 4 billion years ago M32 was probably only 0.03 mag bluer than its present color. Such a small color change is quite consistent with Oke's scans of 3C 295 itself. (auth)

16038 INTENSIFICATION OF GRAVITATIONAL RADIATION BY A MASSIVE ROTATOR. Lawrence, John K. (Univ., Vienna). Astrophys. J.; 171: No. 3, 483-4(1 Feb 1972).

It is hypothesized that a massive, rotating, oblate object exists at the center of the Galaxy, aligned with its plane. Under favorable circumstances, gravitational waves emitted from the interior of the object would be strongly focused by its gravitational field into the galactic plane. An average intensification at the Earth of about an order of magnitude would result. (auth)

16039 MODEL OF THE INTERSTELLAR MEDIUM BASED ON THE INTERSTELLAR CALCIUM AND SODIUM LINES. Pottasch, S. R. (Kapteyn Astronomical Lab., Groningen, Netherlands). Astron. Astrophys.; 17: No. 1, 128-38(Feb 1972).

Use was made of the Ca^0 to Ca^+ ratio in the interstellar medium to deduce the conditions of electron density and temperature prevailing there. The deductions which can be made from the sodium lines combined with the 21-cm hydrogen line both confirm the results of the calcium ratio and indicate that all these lines are formed in the same medium. The properties of this medium were further investigated, using the observations of the pulsar dispersion measure and the "background" radio recombination line measurements. It is shown that the model previously developed can be refined so that it can account for all these measurements. The problem of the abundances in the interstellar medium is also discussed. (auth)

16040 RADIO MAPS OF MAFFEI 2. Love, R. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 235: No. 55, 53-6 (17 Jan 1972).

Radio maps of Maffei 2 in the 1421.6-MHz continuum and the 21-cm H line are reproduced and discussed. The maps were obtained with the half-mile telescope at the Mullard Radio Astronomy Observatory, Cambridge, during March and October 1971. The continuum observations comprised 12-hr runs at each of seven interferometer spacings out to a maximum of 684 m. In order to study the H line, an autocorrelation spectrometer of 39-km/sec velocity resolution was used. Maps of brightness distribution of integrated H I emission are also shown. It is concluded that Maffei 2 is probably an Sb galaxy at a distance of about 4 Mpc, with corresponding properties. No evidence was found to support the hypothesis that Maffei 1 and 2 are related. (UK)

16041 NEUTRAL INTERSTELLAR HYDROGEN IN THE SOLAR NEIGHBOURHOOD. Macchetto, F.; Panagia, N. (Lab. of Spatial Astrophysics, Frascati, Italy). Nature (London) Phys. Sci.; 235: No. 55, 56-8(17 Jan 1972).

Requirements necessary for determinations of the mean volume density of interstellar neutral hydrogen from Lyman absorption measurements are discussed, and the findings are applied to various stars. It is concluded that Lyman and radio measurements of interstellar neutral hydrogen agree and give a mean volume density of ≈ 0.25 atom/cm^3 within 500 pc of the Sun. (UK)

16042 VIRIAL MASS DETERMINATIONS OF BOUND AND UNSTABLE GROUPS OF GALAXIES. Aarseth, Sverre J. (Inst. of Theoretical Astronomy, Cambridge, Eng.); Saslaw, William C. Astrophys. J.; 172: No. 1, 17-35(15 Feb 1972).

Uncertainties inherent in the observational determinations of virial masses for groups of galaxies were investigated. This was done by computing virial theorem masses of small N-body configurations for three different ensembles representing groups of 8, 16, or 32 galaxies. Dynamical evolution, projection effects, and the effects of incomplete data were used to simulate actual observations. Instantaneous departures from equilibrium and projection effects introduced an uncertainty of about 50% in the computed masses. Selection of heavy (and presumably more luminous) members usually produces a significant underestimate of both the actual and projected virial masses of bound clusters. The validity of theoretical assumptions was tested against dynamically consistent configurations of one N-body system with 500 particles. The virial mass derived from cylindrical samples of centrally condensed models also underestimates the actual mass, even though the selected velocities exceed the rms value. The average net result of these effects was to increase the discrepancy between virial and luminosity masses for groups and clusters. The observational implications of the hypothesis that groups of galaxies are unbound and expanding were examined. Detailed models of initial instability or significant mass loss were considered. Groups with positive energy expand rapidly, and the apparent mass discrepancy based on the equilibrium assumption is magnified by the linear growth factor as well as the initial excess. Evolution tracks of virial masses were also computed for several types of mass-loss mechanisms and different rates. A range of mass discrepancies consistent with observations can easily be reproduced from relatively moderate assumptions. Several methods for distinguishing between the hidden-mass hypothesis and the expansion hypothesis were considered. (auth)

16043 FORMATION OF PRIMING MAGNETIC FIELDS DURING THE FORMATION OF PROTOGALAXIES. Mishustin, I. N.; Ruzmaikin, A. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 61: No. 2, 441-4(Aug 1971). (In Russian).

It is shown that weak magnetic fields may arise during the post-recombination stage of evolution of the Universe. Field generation occurs in the presence of proto-galaxy rotation with respect to the homogeneous background of the relict radiation. (auth)

16044 BIAS OF VIRIAL-THEOREM ESTIMATES OF MASS. Sher, D. (Cincinnati Observatory). Astrophys. J.; 171: No. 3, 537-8(1 Feb 1972).

It is shown that the usual procedure for estimating the mass of a cluster by means of the virial theorem leads to an overestimate of up to 30% because the velocity dispersion varies with position in the cluster. (auth)

16045 NEUTRAL HYDROGEN IN AN INTERIOR REGION OF THE GALAXY. THE LONGITUDE INTERVAL 22^0 TO 42^0. II. ANALYSIS OF THE OBSERVATIONS. Shane, W. W. (Leiden Observatory). Astron. Astrophys., Suppl. Ser.; 4: No. 4, 315-93(Dec 1971).

Twenty-one centimeter observations reported in Paper I (Shane 1971a) are presented here in the form of contour maps at constant longitude. Further analysis of the line profiles is described. These are resolved into Gaussian components, whose variation as a function of latitude is studied in order to derive a representation of the data at each longitude in terms of a sum of bivariate normal distributions. The results of the one- and two-dimensional analyses are presented. Certain corrections are applied in the course of the analysis, the most significant being the conversion of observed brightness temperatures to optical depths and the removal of a neutral-hydrogen background component. The influence of these and other corrections is discussed. A discussion of a two-temperature model of the interstellar medium indicates that, if such a model is valid, optical depths derived on the basis of an assumed uniform spin temperature should be considerably increased (10 to 30%, or even more in very dense regions). There is evidence for the existence of an envelope of neutral hydrogen with a width between half-density points of about 700 pc, surrounding the main concentration of H I, which is much more closely confined to the disc. When the contribution from this diffuse envelope is removed, no evidence is found for an increase in the velocity dispersion of the disc component with distance from the plane. The distribution of H I perpendicular to the galactic plane in the disc component can be represented satisfactorily by a Gauss function, but not by an exponential function. (auth)

16046 GALAXIES WITH AN ULTRAVIOLET CONTINUUM. II. Markaryan, B. E. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Eng. Transl.); 5: No. 3, 206-25(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 443-59(1969).

This second list of galaxies with an ultraviolet continuum reported, which is a continuation of the list published in (Astrofizika, 3: 55(1967)). The latter was the first of a series of papers devoted to galaxies with excess ultraviolet emission. The new list contains data on 130 objects discovered in the course of the continuing study of the spectra of weak galaxies. The presence of emission lines was established in the spectra of 29 objects in the new list, and their presence was suspected for 59 objects. For thirteen objects it was suspected that there were features characteristic of Seyfert-type galaxies, and for six there were suspected features characteristic of quasi-stellar galaxies. (W.D.M.)

16047 RELAXATION OF STARS IN PLANE SUBSYSTEMS OF THE GALAXY ON THE SPIRAL STRUCTURE. Marochnik, L. S. (Inst. of Astrophysics, Dushanbe, USSR). Astrophysics (Eng. Transl.); 5: No. 3, 242-6(Jul-Sep 1969).

Translated from Astrofizika; 5: No. 3, 487-98(1969).

In an infinitely thin self-gravitating disk (or cylinder) consisting of differentially rotating stellar Population I and nonrotating stellar Population II, the spiral density waves (identified with the spiral structure of the galaxy) are found to grow as a result of Landau instability. The instability of the density waves leads to the relaxation of stars belonging to Population I. The velocity spread in the galactic plane in the neighborhood of the Sun increases by approximately a factor of two over 10^8 to 10^9 years. A Schwarzschild distribution with the spread ratio $c_r/c_\theta = [1 + (r/2\Omega)\partial\Omega/\partial r]^{-\frac{1}{2}}$ is established in the region of low velocities. In the region of higher velocities the distribution function lies above the Schwarzschild distribution. Growing spiral waves may be responsible for the turbulization of the interstellar gas, but they can hardly be responsible for the relaxation of Population I stars in the z-direction. (auth)

Cosmology

Refer also to abstracts 15966, 15968, and 16857.

16048 DISSIPATIVE EFFECTS IN THE EXPANSION OF THE UNIVERSE. I. Matzner, Richard A. (Univ. of Texas, Austin); Misner, Charles W. Astrophys. J.; 171: No. 3, 415-32(1 Feb 1972).

Dissipative processes in anisotropic homogeneous world models are considered, and it is shown that dissipation reduces the anisotropy. A suitably defined anisotropy energy density can in fact be reduced arbitrarily quickly by collisions involving particles with moderate to long mean free paths. A discussion is given of the viscosity approximation and its range of applicability. Examples are presented which have been calculated by the use of a simple approximation to the collision-time method, using the cross section appropriate to weak-interaction neutrino scattering. It is found that such dissipation is quite effective except for one particular cosmological model which is axisymmetric and in which the entire expansion of the model is taken up by expansion along the axis. A succeeding paper uses a more accurate collision-time formulation, and shows that there is effective heating even in this special model. (auth)

16049 DISSIPATIVE EFFECTS IN THE EXPANSION OF THE UNIVERSE. II. A MULTICOMPONENT MODEL FOR NEUTRINO DISSIPATION OF ANISOTROPY IN THE EARLY UNIVERSE. Matzner, Richard A. (Univ. of Texas, Austin). Astrophys. J.; 171: No. 3, 433-48(1 Feb 1972).

A detailed multicomponent model is developed for dissipative processes in Euclidean homogeneous cosmological models. These processes involve neutrinos which might have long mean free times t_ν, in interaction with other constituents (electrons, photons) which are thermalized by electromagnetic interactions, and whose weak interactions produce thermal neutrinos with mean rate t_e^{-1}. The method used is a mean-free-time approximation generalized to the different rates of destruction and production t_ν^{-1} and t_e^{-1}. It is found that all models which begin collision dominated have effective heating and that this occurs even when the mass fraction of neutrinos is very small, $\kappa = \rho_\nu/\rho \simeq 10^{-7}$. It is also found that the neutrinos are replenished sufficiently to maintain their number at roughly the adiabatic value, so that heating is not stopped by the depletion of neutrinos. Finally, it is pointed out that extremely long mean free paths (less than 0.01 collisions per radius of the Universe) can still give very effective heating. The solutions cannot be described by power laws in the time t, although some of the parameters of the solution can be so described. (auth)

16050 EFFECT OF TEMPERATURE VARIATIONS ON THE PRIMEVAL PRODUCTION OF HELIUM. Ipavich, Fred M. (Univ. of Maryland, College Park). Astrophys. J.; 171: No. 3, 449-50 (1 Feb 1972).

Random temperature fluctuations in the primeval fireball are shown to lead to an increase in the cosmic helium abundance relative to the abundance in the absence of such fluctuations. This conclusion is opposite to that reached by Silk and Shapiro (Astrophys. J., 166: 249(1971)). (auth)

16051 NONLINEAR CONDENSATIONS IN SELF-GRAVITATING MEDIA. II. AN ANALYTICAL APPROACH. Tassoul, Jean-Louis; Tassoul, Monique (Univ. of Montreal). Astrophys. J.; 171: No. 3, 495-501(1 Feb 1972).

The nonlinear gravitational instability of infinite homogeneous media is considered. Second-order asymptotic expansions are constructed to describe small- but finite-amplitude motions. It is shown that, for compressible gaseous systems, nonlinearity slightly increases the critical wavelength beyond which flow patterns become a growing function of time. For most cases of astronomical interest, this nonlinear correction to the Jeans length remains utterly negligible. (auth)

16052 SPHERICALLY SYMMETRIC INHOMOGENEOUS COSMOLOGICAL MODEL. Dodson, C. T. J. (Univ. of Lancaster, Eng.). Astrophys. J.; 172: No. 1, 1-8(15 Feb 1972).

The model derives from a diagonal metric tensor with components $g_{\alpha\alpha} = R^2(t)e^{-\lambda r}$, $\alpha = 1, 2, 3$, $g_{44} = -1$, where $\lambda \geq 0$ is constant. The case $\lambda = 0$ reduces to the Einstein–de Sitter model. When $\lambda \neq 0$, an evolutionary bounded Universe is obtained with a center at $r = 0$ and a plausible distribution of matter. The time elapsed since an initial singularity is identically H^{-1}, the Hubble age. At the present epoch a total proper mass of 10^{23} $M_\odot$ is contained within a naturally bounded proper volume of 10^{85} cm^3; surrounding $r = 0$ a sphere of solar radius contains $\sim 10^{-12}$ $M_\odot$ and a sphere of galactic radius contains $\sim 10^{12}$ $M_\odot$; pressure is virtually isotropic with mean value $\sim 10^{-7}$ dyn cm^{-2}; the mean density of matter is 1.2×10^{-28} g cm^{-3}; the spectral shift relation is not inconsistent with current data; matter is created at the current rate of 2.8×10^{-46} g cm^{-3} s^{-1}, which is the value demanded by homogeneous and inhomogeneous steady-state models. (auth)

16053 TESTS FOR SUPERCLUSTERING OF ABELL CLUSTERS. Fullerton, Wayne; Hoover, Paul (Univ. of Michigan, Ann Arbor). Astrophys. J.; 172: No. 1, 9-16(15 Feb 1972).

Abell's catalog of rich clusters of galaxies was examined for evidence of second-order clustering in three dimensions. Although the serial correlation coefficient by itself implies that superclustering exists, this result was not interpreted as evidence for superclustering. Instead, further tests were carried out in order to show that systematic errors in the catalog are most probably the reasons why the serial correlation coefficient is large. The two-dimensional distribution of clusters on the sky was also reanalyzed with the χ^2 test in order to examine the angular scale of apparent superclustering as a function of distance. No correlation with distance was found. In order to study the influence of selection effects on the distribution of clusters and in order to see whether superclustering is evident by visual inspection, a stereoscopic pair of three-dimensional perspective plots of Abell's catalog was generated. The influence of apparent digit preferences was plainly visible as concentric shells of clusters of galaxies. The results cannot be interpreted as evidence against superclustering. The results do, however, call into question the use of several statistical tests on data which are influenced by selection effects. (auth)

16054 NONLINEAR CONDENSATIONS IN SELF-GRAVITATING MEDIA. I. A NUMERICAL APPROACH. Tassoul, Jean-Louis; Pellieux, Gerard (Univ. of Montreal). Astrophys. J.; 171: No. 3, 485-93(1 Feb 1972).

Within the framework of Newtonian mechanics, the evolution of finite-amplitude fluctuations in extended self-gravitating media was investigated. Pressure effects were fully taken into account. For initial disturbances with wavelength λ smaller than the Jeans length λ_J, nonlinear motions always remain bounded in time; in that range, numerical solutions exhibit quasi-periodic flow patterns. For $\lambda \gtrsim \lambda_J$, irrespective of their initial amplitude ϵ, fluctuations grow in time. The corresponding growth rate, however, depends strongly on ϵ; in addition, very large departures from the well-known linear description were observed. (auth)

16055 ANALOGS OF HOMOGENEOUS ANISOTROPIC MODELS OF GENERAL RELATIVITY IN NEWTONIAN COSMOLOGY. Shikin, I. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 61: No. 2, 445-53(Aug 1971). (In Russian).

The problem of Newtonian analogues defined as limiting states for $c \to \infty$ is considered in a general form for relativistic homogeneous anisotropic models. Expressions for intervals in synchronous and inertial systems with Eulerian coordinates are compared in the Newtonian approximation. The problem of construction of

homogeneous models within the framework of Newtonian cosmology and, in this connection, the problem of the Newtonian gravitational paradox, are discussed. Newtonian analogues for relativistic models with matter possessing transitivity hypersurfaces orthogonal to the 4-velocity and analogues for vacuum models (in particular, for the Bianchi type IX model) are considered. (auth)

16056 PHOTON REST MASS AND ELECTROMAGNETIC DISPERSION IN COSMOLOGY. Burman, R. R. (Univ. of Western Australia, Nedlands). Phys. Lett.; 38A: No. 2, 96(17 Jan 1972).

The effect of a photon rest mass on electromagnetic dispersion is calculated for the steady-state and Einstein–de Sitter cosmologies. (auth)

16057 PHYSICAL CONDITIONS AND EVOLUTION IN THE HADRON ERA. Meszaros, P. (Univ. of California, Berkeley). Nature (London) Phys. Sci.; 235: No. 55, 50-2(17 Jan 1972).

The hadronic equation of state is discussed in the light of recent developments concerning an ultimate temperature. The value of the adiabatic exponent γ is determined and found to be less than $4/3$. This is applied to Friedman universes to evaluate the effects on the expansion rate and on the growth of fluctuations during the hadron era. (auth)

16058 VELOCITY-DOMINATED SINGULARITIES IN IRROTATIONAL DUST COSMOLOGIES. Eardley, D.; Liang, E.; Sachs, Rainer (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 13: No. 1, 99-107(Jan 1972).

Irrotational dust solutions of the Einstein equations are considered, and "velocity-dominated" singularities of these solutions are defined. It is shown that a velocity-dominated singularity can be considered as a three-dimensional manifold with an invariantly and uniquely defined inner metric tensor, extrinsic curvature tensor, and scalar bang time function. This structure was computed for a variety of known exact models. The structure of the singularity uniquely determines the solution in a certain class of spatially inhomogeneous models. The b boundary (Schmidt boundary) is discussed, conformal transformations are generalized to "stretch" transformations, and the curvature form of a stretched metric is calculated. (auth)

16059 GRAVITATIONAL RADIATION IN THE PRESENCE OF A SCHWARZSCHILD BLACK HOLE. A BOUNDARY VALUE SEARCH. Davis, M.; Ruffini, R. (Princeton Univ., N. J.). Lett. Nuovo Cim.; 2: No. 23, 1165-8(4 Dec 1971).

Preliminary results are presented from which it is concluded that: (1) at the frequency examined the amount of gravitational radiation as computed is substantially larger than that predicted by the linearized slow-motion approximation of the theory of gravitation (Ruffini and Wheeler 1971); and (2) a large amount of gravitational radiation appears to fall into the black hole, and the amount of this radiation appears to be substantially larger than the radiation escaping at infinity. (W.D.M.)

Planetary Phenomena

Refer also to abstracts 14686 and 16111.

16060 MAGNETOSPHERES OF JUPITER AND SATURN. Haffner, James W. (North American Rockwell Corp., Downey, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 9: No. 12, 2422-7(Dec 1971).

Calculations were carried out to estimate the characteristics of the magnetospheres around the planets Jupiter and Saturn. Solar wind characteristics near these planets were deduced from those near the Earth, using standard hydrodynamic equations. Planetary magnetic fields were estimated from nonthermal rf emissions, which were assumed to be synchrotron radiation. (Nonthermal radiation from Saturn has not been confirmed, so only a possible upper limit was used for that planet.) Based upon energy density relationships, the calculated standoff distances are $\sim 40R_J$ and $\lesssim 50R_S$ for Jupiter and Saturn, respectively; corresponding calculated magnetospheric tail lengths are ~ 0.5 and $\lesssim 0.7$ au. Jupiter's Van Allen belts are $\sim$ an order of magnitude more intense than the Earth's, while Saturn's are $\lesssim$ an order of magnitude less than the Earth's. Centrifugal flattening does not appear to be a major effect for either planet's belts. (auth)

16061 ELECTROMAGNETIC MODE IN CONTRA-STREAMING THERMALLY ANISOTROPIC PLASMAS IN A MAGNETIC FIELD. Vithal, K. L.; Tandon, J. N. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 556-60(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Electromagnetic waves propagating across an external magnetic field are investigated for a system composed of two identical contrastreaming thermally anisotropic plasmas. It is found that the extraordinary wave is unaffected by relative streaming, while the ordinary wave gets modified. For the electron–electron streaming, it is shown that an electromagnetic instability can be excited at streaming velocities that can be below the threshold value necessary for the corresponding electrostatic two-stream instability. Typical growth rates for this electromagnetic instability are of the order of electron-cyclotron frequency. Plasmas pervading the interplanetary medium at about 1 A. U. are stable against this instability. The investigation is further extended to take into account the finite mass of the ions by allowing them to possess streaming motion, and the results are briefly discussed. (auth)

16062 RADIOACTIVE HEAT SOURCES IN THE LUNAR INTERIOR. Hays, James Fred (Harvard Univ., Cambridge, Mass.). Phys. Earth Planet. Interiors; 5: No. 1, 77-84(Jan 1972).

Published models for the Moon's thermal history typically imply present-day central temperatures far too high to be consistent with the recently proposed lunar temperature profile of Sonett and others, inferred from apparent electrical conductivity of the lunar interior. Furthermore, chemical data on Apollo samples show that the Moon is depleted relative to chondrites in volatile elements, including potassium, and possibly enriched relative to chondrites in refractory elements, including uranium and thorium. Therefore, additional thermal models were investigated in order to set upper limits on lunar radioactivity consistent with the proposed temperature distribution. For an initially cold, uniform Moon, devoid of potassium, a maximum uranium content of 23 parts per billion is inferred. This is about twice the chondritic value and an order of magnitude less than the least radioactive lunar rock samples. Accretional heating and more realistic K/U ratios imply still lower uranium contents. Surface concentration of radioactive heat sources is probable only if deep melting has occurred. This, too, implies present-day central temperatures greater than 1400°C. Either the Moon has a most unusual geochemistry or the Sonett et al. temperature distribution is grossly in error. (auth)

16063 CHEMICAL COMPOSITION OF SAWDUST FROM LUNAR ROCK 12013 AND COMPARISON OF A JAVA TEKTITE WITH THE ROCK. Showalter, D. L. (Oregon State Univ., Corvallis); Wakita, H.; Smith, R. H.; (and others). Science; 175: No. 4018, 170-2(14 Jan 1972).

Abundances of 11 major and minor elements and 11 trace elements were determined by instrumental neutron activation analysis of two Apollo 12013 rock fragments, a sample of rock 12013,17 sawdust, and a Java tektite (J2). Although the abundances of major elements in tektite J2 were similar to those of rock 12013, comparison of the minor and trace elements showed that no fragment or sawdust of rock 12013 analyzed to date was chemically similar to tektite glass. Rock sawdust is representative of "whole rock" composition only if the amount of contamination from the sawing process is known. After appropriate correction for saw wire contamination, analyses of sawdust yielded fairly accurate averaged elemental compositions of complex clastic lunar and other rocks. (auth)

PHYSICS (ATMOSPHERIC)

16064 INTERPRETATION OF GLOBAL GRAVITY ANOMALIES. Higbie, J. W.; Stacey, F. D. (Univ. of Queensland, Brisbane). Nature (London) Phys. Sci.; 234: No. 50, 130-2 (13 Dec 1971).

The absence of any significant correlation between large-scale topographic features of the Earth's crust and the undulations of the geoid indicates near perfection in the isostatic balance of continent-sized features, whereas local geological features do cause distinct gravity anomalies. The anomalies may be due to undulations of either or both of the phase boundaries centered at 350 to 400 km and 650 to 700 km. A contour plot of the boundary which is actually required to produce the geoid is shown. The supposed correlation between gravity and heat flow was examined, but no significant correlation was found. (UK)

Auroral and Ionospheric

Refer also to abstract 16110.

16065 (UCRL-Trans-10572) GAS DYNAMICS OF THE FLIGHT AND EXPLOSION OF METEORITE BODIES IN THE EARTH'S ATMOSPHERE. Korobeinikov, V. P.; Chushkin, P. I.; Shurshalov, L. V. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from 3rd International Colloquium on the Gas Dynamics of Explosions, Marseille, France, September 12–17, 1971. 30p. (CONF-710918-2). Dep. NTIS.

The aerodynamic properties of blunt bodies moving at hypersonic velocities in the atmosphere are discussed, and a model of the explosion of meteorites is investigated. The explosion of the Tunguska meteorite, which took place in Siberia on June 30, 1908, is used as an example. (J.C.W.)

16066 UPPER ATMOSPHERE HEATING NEAR THE AURORAL ZONES. Allan, R. R. (Royal Aircraft Establishment, Farnborough, Eng.). Nature (London); 235: No. 5333, 100-2(14 Jan 1972).

Using results from the Russian communications satellites Molniya IK, a discussion is presented on the density of the upper atmosphere above about 400 km near the southern auroral zone. Heating mechanisms, leading to density changes, are discussed; these include magnetic activity and charged-particle precipitation. (UK)

16067 MIDLATITUDE AURORAL ARCS OF 6300 A (O I) AND THE CONCURRENT IONOSPHERIC CURRENT SYSTEM. Okuda, M.; Old, T.; Kim, J. S. (State Univ. of New York, Albany). Radio Sci.; 6: No. 10, 887-91(Oct 1971).

A multiple midlatitude 6300-Å auroral arc occurred during the recovery phase of a geomagnetic storm on March 8/9, 1970. Variations of the arcs were characterized by a southward shift in position and by a diminution in intensity with time before midnight. During the recovery phase of the storm, well-defined magnetic-baylike disturbances occurred. Variations in both position and brightness of the concurrent arc were strongly correlated with changes in the H and D components of these geomagnetic-field deviations. An equivalent current system is determined from these baylike-disturbance fields observed at twenty-six magnetic observatories for periods when the correlation was strongest. The current system found is similar to that of the DP-1 field, with a superimposed DP-2 field. The changes in these fields that are associated with the baylike disturbances are presented to account for the transient variations observed in the intensity and position of the midlatitude auroral arc. (auth)

16068 RAM EFFECT IN SOUNDING ROCKETS. Koehler, J. A.; Kavadas, A. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 49: No. 20, 2572-7(15 Oct 1971).

When a conducting body moves through a plasma, it collects charges. When the conductor has reached its floating potential the collection rates at the front and back differ and a current flows through the conductor. This "ram current" if measured may provide a simple way of determining the ambient ion density. The "ram current" is examined and the derived equations are used to calculate ion densities from a rocket flight. Simplifying assumptions and errors in the technique are discussed. (auth) (Canada)

16069 SYMPOSIUM ON IONOSPHERE–MAGNETOSPHERE INTERACTIONS, NEW DELHI, FEBRUARY 1971. Indian J. Pure Appl. Phys.; 9: No. 8, 493-676(Aug 1971). (CONF-710221).

Separate abstracts were prepared for 41 of the 44 papers. Two remaining papers dealt with temperature variations and satellite transmissions and are out of scope for NSA; one paper appeared previously as NSA 25: 9291. (J.C.W.)

For abstracts of individual papers see: 15980, 16061, 16070–16099, 16106–16111, 16635, 16747, and 16856.

16070 INFLUENCE OF MAGNETOSPHERIC HEAT FLUX ON PLASMA TEMPERATURES AND COMPOSITION IN THE TOPSIDE IONOSPHERE. Rao, B. C. Narasinga (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 501-3 (Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The effects of conduction of the magnetospheric heat flux on the height variation of electron and ion temperatures and ion composition in the topside ionosphere are studied theoretically for different latitudes. It is found that the topside heat flux, which increases with latitude, controls both the temperature and the composition variations. In the height range 400 to 1000 km, the results show that both electron and ion temperatures and the percentage of O^+ ions increase with latitude. These theoretical results are in agreement with the observational data. (auth)

16071 GEOMAGNETIC CONTROL OVER THE LATITUDE VARIATION OF TOTAL ELECTRON CONTENT IN EQUATORIAL REGION. Das Gupta, A.; Basu, S. (Centre of Advanced Study in Radio Physics and Electronics, Calcutta). Indian J. Pure Appl. Phys.; 9: No. 8, 509-11(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The latitude variation on noontime electron content of the ionosphere in the equatorial region was studied under varying magnetic conditions. It was found that within 3 hr of storm commencement this latitude variation becomes more pronounced as compared to a magnetically quiet day, but beyond 3 hr of commencement time the variation is inhibited. The results are discussed in terms of electrodynamic drifts in the equatorial ionosphere. (auth)

16072 ESTIMATION OF NEUTRAL ATMOSPHERIC TEMPERATURE FROM CHARGED PARTICLE MEASUREMENTS IN THE TOPSIDE IONOSPHERE. Mahajan, K. K.; Saxena, O. P. (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 516-18(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A method is presented to show that charged-particle measurements in the topside ionosphere can be used to deduce the scale height and, thus, the temperature of the neutral atmosphere. Some incoherent-scatter radar measurements of electron and ion temperatures and electron concentration in the height range 400 to 550 km are used to test this method. The neutral temperatures obtained by this method are compared with the ion temperature measurements at 250 km, where the ions are expected to be in thermal contact with the neutrals, and an excellent agreement is seen between the two. A comparison of the neutral temperature values from charged-particle measurements with those of the CIRA (1965) shows that the model temperatures are overestimated by about 100°K at low as well as high solar activity. (auth)

16073 VARIATION OF ELECTRONIC COLLISION FREQUENCY IN THE F REGION. Setty, C. S. G. K.; Nagpal, O. P.; Dhawan, V. K. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 519-21(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The electronic collision frequency variation with radio frequency in the F region was studied, in addition to its height, diurnal, and seasonal variations, using a manually operated variable-frequency ionosonde. It was found that the collision frequency increases linearly with the square of the radio frequency over the range 8.5 to 15.0 MHz. A preliminary study shows that the height variation of the collision frequency is insignificantly small, whereas it shows a regular seasonal variation, increasing from $(3.5 \pm 0.2) \times 10^3$ sec^{-1} in summer to $(4.2 \pm 0.2) \times 10^3$ sec^{-1} in equinox and to $(4.6 \pm 0.3) \times 10^3$ sec^{-1} in winter. The diurnal variations of annual mean values go through significant maxima near 1200, 1900 and after 2200 hrs IST and minima near 1500 and 2000 hrs IST. (auth)

16074 INTERACTION BETWEEN HYDROMAGNETIC AND ACOUSTIC GRAVITY MODES AT IONOSPHERIC HEIGHTS. Verma, Pratibha (Univ. of Delhi); Verma, Y. K. Indian J. Pure Appl. Phys.; 9: No. 8, 522-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The wave–wave interaction between the hydromagnetic and acoustic gravity waves in the atmosphere is considered. A model of stratified, nonisothermal atmosphere is consídered for the propagation of adiabatic acoustic–gravity waves, and the geomagnetic field is taken in the Y–Z plane. A normal mode analysis of the linear perturbation theory reveals that the acoustic gravity modes get coupled with the hydromagnetic modes. As the coupled equations for the general case are very difficult to be solved, Wentzel–Kramers–Brillouin (WKB) solutions are obtained for the case of vertical propagation under the geometrical-optics approximation. The dispersion equation reveals that the wave interaction can take place in a region where the Alfvén speed can be equated to the sound speed in the atmosphere. Referring to the CIRA model atmosphere, it is found that the wave interaction can take place at the ionospheric heights between 120 and 160 km, depending upon time, latitude, and the sunspot-cycle variations. The propagation of energy from this region of "wave interaction" is partially responsible for the high ionization in the E region at irregular intervals (sporadic E) and can also serve as a cause for some small-scale irregularities in the F-region electron density. (auth)

16075 ELECTROJET EFFECTS ON THE EQUATORIAL F REGION DURING MAGNETICALLY QUIET AND DISTURBED DAYS. Rastogi, R. G.; Rajaram, Girija (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 531-6(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The critical frequency of the F2 region at stations close to the crest and trough of the equatorial anomaly in the Asian zone was studied in relation to the equatorial electrojet strength. It is shown that the midday bite-out in f_0F2 at an equatorial station and the afternoon peak of f_0F2 at a midlatitude station are greatly enhanced on days of strong electrojets; on some weak electrojet days the noon bite-out of f_0F2 at Kodaikanal is completely absent. Regarding the day-to-day variations, f_0F2 at Kodaikanal is shown to decrease and at Ahmedabad to increase steadily with the increase of equatorial electrojet estimated by the difference in daily range of H between Trivandrum and Alibag. Electron-density profiles computed for Kodaikanal indicate that the "fountain" effect is operative normally at heights above 180 km and is greatly reduced or absent on a weak electrojet day or on magnetically disturbed days. The diffusion of electrons along the geomagnetic lines of force from the equatorial regions starts at higher altitudes in the morning, and gradually extends to the lower regions by midday; in the afternoon hours, the deficit of electrons during strong electrojet days or magnetically quiet days vanishes first at lower heights. It is concluded that the behavior of the F2-region at equatorial stations during magnetically disturbed days is equivalent to that on weak electrojet days. Thus, the equatorial-electrojet current decreases in strength during magnetically disturbed days; it is suggested that this decrease is due to weakening of the equatorial east–west electrostatic field during magnetic disturbances. (auth)

16076 IONOSPHERIC F2-LAYER DISTURBANCES AT LOW LATITUDES: A STATISTICAL STUDY. Jani, K. G.; Kotadia, K. M. (Gujarat Univ., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 537-41(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A study is made of the ionospheric F2-layer changes associated with a large number of sudden-commencement-type geomagnetic storms that occurred during the seven years 1957–1963. The analysis covers the stations with magnetic dip in the range –47 to +61°. Statistical data are given for the occurrences of positive and negative F2 storms in different seasons and also for similar and dissimilar types occurring simultaneously at the conjugate places. A comparison is made of DS and Dst variations of f_0F2 at different stations. (auth)

16077 EXPLAINING MAGNETIC STORM PHENOMENA IN THE UPPER ATMOSPHERE AND IONOSPHERE. Stubbe, P. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Indian J. Pure Appl. Phys.; 9: No. 8, 542-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The changes of the ion and neutral compositions and of the neutral, ion, and electron temperatures during the main phase of a magnetic storm are studied by solving a system of basic ionospheric and atmospheric differential equations. It is shown that a decrease of the atomic-to-molecular concentration ratio, $[O]/([O_2] + [N_2])$, in the lower thermosphere is able to explain the following phenomena observed during a magnetic storm: (1) a decrease of N_mF2, the maximum F2-layer electron concentration; (2) an increase of the ratio N_mF1/N_mF2 due to a decrease in $[O^+]$ and an increase in $[NO^+]$, N_mF1 may even be greater than N_mF2, giving rise to the so-called G condition; (3) a decrease of the columnar electron content; and (4) an increase in the neutral temperature. (auth)

16078 GEOMAGNETIC INFLUENCE OF LONGWAVE PROPAGATION. Ramanamurty, Y. V.; Prakasa Rao, V. R. K. S. (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 546-7(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Geomagnetic influence on the lower ionosphere at a lower midlatitude station (geogr. lat., 35°4′N; long., 73°24′E; $\Phi \approx 25°$; and $I \approx 52°$) was studied using low-frequency propagation data. The results of the study show delayed ionospheric effects associated with the enhanced geomagnetic activity. (auth)

16079 CHANGES IN ELECTRON CONTENT DURING THE MAY 25–26, 1967 MAGNETIC STORM EVENT. Somayajulu, Y. V.; Sehgal, A. K.; Tyagi, T. R.; Negi, N. K. (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 548-52 (Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Published data on the electron content monitored from geostationary satellites at several locations are used to identify changes during the storm event of May 25–26, 1967. Sharp and large changes in the electron content over a range of longitudes in the midlatitude sector reported separately are shown to be more or less coincident in universal time. The sharp rise and decay of the electron-content enhancements are shown to be correlated with the occurrence of two substorms that mark the development of main phase of the magnetic storm. The electrodynamic drift produced by the current system associated with these substorms in midlatitudes is considered to be responsible for the observed ionospheric changes. The enhanced electron content during the night following the first substorm is interpreted to be due possibly to ionospheric heating in higher midlatitudes. (auth)

16080 MAGNETO-IONIC THEORY INVOLVING LORENTZ POLARIZATION. Agarwal, D. C. (Univ. of Allahabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 564-7(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The effects due to Lorentz polarization term on the general complex refractive index and wave polarization of the magneto-ionic theory are studied. The resulting equations are discussed for both the large and small values of the parameters $Z_e = (\nu_e/\omega)$ and $Z_i = (\nu_i/\omega)$. The special case in which there is no magnetic field is also considered. It is concluded that the Lorentz term must not be included in the equation of motion that is consistent with the previous results. (auth)

16081 PROPAGATION OF A RECTANGULAR PULSE AS A PLASMA DIAGNOSTIC. Singh, K. P.; Shukla, P. K.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 570-2(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The propagation of a rectangular envelope carrier pulse through an inhomogeneous medium is proposed as a plasma diagnostic. The effect of electron collisions and other plasma parameters in producing the distortion of signal is studied. The distortion thus produced in the rectangular pulse is compared with that for the Gaussian carrier pulse. It is observed that the rectangular pulse is more distorted and, hence, it helps in the study of plasma parameters. (auth)

16082 HEATING OF ELECTRONS BY OSCILLATING ELECTRIC FIELD IN THE PRESENCE OF STEADY MAGNETIC FIELD. Shukla, P. K.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 573-6(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The Boltzmann transport equation is solved for an electron velocity distribution in a weakly ionized plasma under the following conditions: (i) when an oscillating electric field with a constant amplitude is applied perpendicular to the static uniform magnetic field; (ii) when there is a change in electron energy due to elastic

collisions with the neutral particles; and (iii) existence of thermal equilibrium of the plasma, i.e., the average electron energy being equal to the mean thermal energy of a neutral particle. The perturbed velocity distribution function is obtained as a function of the electric field imposed, its oscillating frequency, time, and the strength of the magnetic field. The energy balance equation for electrons is obtained from kinetic and statistical considerations. The electron temperature in the plasma is estimated by solving the energy-balance equation. This study suggests that the electron temperature is strongly dependent on the strength of the oscillating electric field, steady magnetic field, and collision processes of electrons. (auth)

16083 MECHANISM FOR MULTIPLE EMISSIONS IN THE WHISTLER MODE. Das, A. C.; Vyas, N. K. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 577-9(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The model for vlf emissions proposed earlier by Das (J. Geophys. Res.; 73: 7457 (1968)) was extended to include the effect of wave–particle interactions for a large-amplitude whistler-mode wave packet. The particles are redistributed and the growth rate, which depends on the distribution function, is computed for the disturbed distribution. The nature of the growth rate remains more or less the same as that for the case of a small-amplitude wave packet while the peaks in the growth rate, which occur at frequencies slightly above and below the central frequency, are further enhanced by a considerable amount. These enhancements then give enough amplification for vlf emissions to be seen and may also explain some of the duplicate traces in the whistler mode observed at a low-latitude station. In the case when the wave packet is very wide and strong, several peaks in amplification occur on both sides of the central frequency, which may explain some of the observed multiple emissions. (auth)

16084 LOW DISPERSION WHISTLERS AT LOW LATITUDES. Dikshit, S. K.; Laimani; Somayajulu, V. V.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 580-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Results of a study of low-dispersion whistlers with dispersion varying from 10 to 20 $sec^{\frac{1}{2}}$ recorded simultaneously at Gulmarg (geomag. lat., 24°10′N) and Naini Tal (geomag. lat., 19°1′N) are presented. It is suggested that the low-dispersion whistlers recorded simultaneously are the vlf waves radiated from the return stroke of the lightning discharge launched at the ionosphere with different initial-wave normal angles, propagated upwards under either quasi-longitudinal conditions or pro-longitudinal whistler mode, turned around at different heights due to quasi-transverse propagation, and received at Naini Tal and Gulmarg simultaneously with the dispersions of the order of 10 and 15 $sec^{\frac{1}{2}}$, respectively. Further, it is proposed that since the vlf waves propagated quasi-longitudinally or with the pro-longitudinal whistler mode and have spent only a very small amount of time in the transverse propagation, the low-dispersion whistlers are found to obey Eckersley's law. Among the low-dispersion whistlers recorded at Gulmarg, there are some peculiar whistlers having twin traces with a constant time difference of 15 msec at all frequencies. A critical discussion is presented about the possibility of these whistlers being the hook whistlers proposed by S. D. Shawhan [Tech. Rep. 66-33, Univ. Iowa, 1966] or duplicate trace whistlers having hybrid paths proposed by T. Araki and H. Kamiyama [Rep. Ionosph. Space Res. Japan, 23: 142 (1969)] or multiflash whistlers with an unusually small time interval between the multistrokes. (auth)

16085 STUDY OF SMALL-SCALE IRREGULARITIES IN F REGION AT VARANASI. Srivastava, S. K.; Pradhan, S. M.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 605-8(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The various processes of the contaminations of the fading records, which have to be discarded for the reliable measurements of the horizontal drifts and anisometric parameters of the small-scale ionospheric irregularities, are discussed. Histograms of the reliable, apparent, and true-drift velocities and directions, axial ratios, and orientations, and rms values of random velocity of the irregularities in F region are drawn, and the decrease of the drift speed with higher latitude is discussed in the light of the present theoretical views. The rms values v_0 of the random velocity of the small-scale irregularities are determined by correlation and time-analysis methods, both for random and focusing events. The difference in values of v_0 obtained by the two methods in the case of the focusing events is attributed to the dominating steady component that steepens the auto-correlation curve thereby increasing the value of v_0. A positive correlation between the apparent drift speed and magnetic activity is obtained, and this is explained in terms of the gravity waves. (auth)

16086 STUDY OF TRAVELLING IONOSPHERIC DISTURBANCES AT VARANASI DURING NIGHTTIME. Srivastava, S. K.; Pradhan, S. M.; Singh, B.; Tantry, B. A. P. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 609-12 (Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A detailed study of the characteristics of traveling ionospheric disturbances (TID), both in the E and F regions of ionosphere at the low-latitude station, Varanasi (geomag. lat., 16°24′), during night hours was made. The speed and direction of the movement of perturbations were estimated from the simultaneous records of amplitude and phase path changes at three closely spaced receivers. It is found that the speed, horizontal extent, and the vertical amplitude of TID increase from the E to the F region, which supports the formation of TID due to internal atmospheric gravity waves. A positive correlation between the frequency of occurrence of TID and the vertical drift of the F layer was also obtained. (auth)

16087 STUDY OF DRIFT AND ANISOTROPY OF F-REGION IRREGULARITIES AT WALTAIR DURING IQSY. Sastri, J. Hunumath; Rao, B. Ramachandra (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 9: No. 8, 613-17(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Results obtained from the correlation analysis of closely spaced aerial fading records taken during IQSY were studied to yield information about features like diurnal and seasonal variations of drift and anisotropy parameters, effect of magnetic activity, and interrelationships between the parameters. It is evident that there exists a marked diurnal variation in random velocity with the average value of the same for the daytime period greater than that for the nighttime period. The effect of magnetic activity is to decrease the average values of true drift speed, random velocity, and structure size. The magnitudes of the true drift speed are found to be correlated to a statistically significant level with those of random velocity and structure size, the later relationship being observed for the first time using the D_1 method. (auth)

16088 DRIFT INSTABILITIES IN IONOSPHERIC PLASMA. Jain, R. K.; Das, A. C. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 618-25(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A theory of drift instabilities in an inhomogeneous plasma in presence of a uniform magnetic field and a steady electric field is discussed. The dispersion relation is obtained and the growth rate is computed for a number of situations applicable to the equatorial region of the ionosphere in the altitude range 85 to 175 km. It is seen that the growth is controlled not only by the electric field and the gradient of electron density but also by other ionospheric conditions such as the nature and extent of collisions. In general, the scale size of the instabilities is seen to be inversely proportional to the electric field. The study of instabilities is then extended for particular electron density and temperature profiles. The growth-rate and scale-size computations for different values of $a[= (1/n_0)(\partial n_0/\partial x)]$ show that the growth rate increases while the scale size decreases with increasing fluctuation of the electron density. This further reduces the scale size. The day- and night-time irregularities are identified and the computed scale size of both vertical and horizontal irregularities ranges from 20 m to a few kilometers. The results, therefore, seem to explain some of the features of small-scale irregularities observed in the ionosphere. (auth)

16089 NIGHTTIME E REGION AT THUMBA. Subbaraya, B. H.; Prakash, Satya; Gupta, S. P. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 626-30(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Two Langmuir probe payloads were flown from Thumba during the night at nearly the same local time on two quiet days ($\Sigma K_p = -4$) for the investigation of the nighttime equatorial E region. The electron-density profiles obtained on these two nights showed some common general features such as the existence of electron densities of 10^3 to $10^4/cm^3$ in the region 90 to 115 km as well as the region above 140 km with a valley separating the two regions.

The existence of such electron densities in the nighttime requires the presence of nighttime sources of ionization. The electron-density profiles on the two nights show some marked differences. While one of the profiles (obtained on March 12, 1967) can, within reasonable margins, be reconciled with theoretical calculations based on the presence of scattered ultraviolet radiations in the night sky, the other profile (obtained on Aug. 29, 1968) exhibits large departures from the calculations. The electron-density profile in the region above 140 km is seen to be significantly affected by the presence of vertical motions. Even in the region below the valley, while the total electron content (per cm^2 vertical column) could be due to similar fluxes of scattered Lyman-α and Lyman-β radiations, the large differences in the shapes of the two profiles suggest that the electron density at a given height is subject to readjustments due to vertical motions. The nature of such motions and the mechanism of transport (especially at the equator) are not yet clear. (auth)

16090 LOW-LATITUDE DYNAMICS OF 6300 A NIGHTGLOW EMISSION AND F2 LAYER ON JAN. 31–FEB. 1, 1968. Kulkarni, P. V.; Rao, V. R. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 631-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Photometric data of 6300-Å night airglow emission at Mt Abu on the night of Jan. 31–Feb. 1, 1968, show an unusual airglow activity. A tropical 6300-Å arc shows itself right from the beginning of the night, then closes, gets stronger, and moves towards the magnetic equator by midnight. Ionospheric data from Ahmedabad show a large electron content and movements of the F2 layer during the night. These connecting phenomena on that night are described and discussed. The characteristics of the 5577-Å emission component due to the F2 layer are also mentioned. (auth)

16091 SOME DAY-GLOW EMISSION FEATURES OF MOLECULAR NITROGEN. Sharma, V. N.; Singh, Raghubir; Singh, Dinesh; Singh, S. N.; Tolpadi, S. K. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 636-8(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The photoelectron impact excitation is a dominant mechanism for most of the spectral emissions in dayglow. Using the results for the total production rate for photoelectrons in three different cases, namely low, medium, and high solar activity, corresponding to CIRA (1965) models 2, 5, and 8 (1200 hrs, $\chi = 0$) and also for the photoelectron energy loss per unit length from a previous paper by Sharma et al. [Indian J. Pure Appl. Phys., 9: 649 (1971)] the height profiles of the volume emission rates are calculated for the Lyman–Birge–Hopfield, Birge–Hopfield, Janin, Watson–Koontz, and Gaydon–Herman band systems. The cross sections for the electron impact excitations of R. T. Brinkmann and S. Trajmar [Annls Geophys., 26: 201 (1970)] and J. M. Ajello [J. Chem. Phys., 53: 1156 (1970)] are used for these calculations. The results for Birge–Hopfield and Janin systems are not given separately as they arise from the same upper level populated by photoelectron impact. An attempt is made to include all the states that contribute to the downward cascading. The height profiles of the intensities of these band systems are obtained by integrating the resulting volume emission rates, and it is observed that they compare well with earlier results. (auth)

16092 EMISSION OF 5577 A RADIATIONS IN THE NIGHT AIRGLOW FROM THE F LAYER AT POONA. Tilu, A. D.; Chiplonkar, M. W. (Univ. of Poona, India). Indian J. Pure Appl. Phys.; 9: No. 8, 639-43(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Previous analysis of the ground-based observations of the night airglow at this station is extended further to obtain a better estimate of the F-layer contribution to the observed intensity of 5577-Å emission. Three parameters are taken into account: (i) the time of occurrence of maximum in the nocturnal variation of intensity of this radiation; (ii) the nature of the frequency distribution of the observed mean van Rhijn ratio for this radiation during night; and (iii) the residual scatter (after removing contributions due to patchiness and total extinction) in the mean van Rhijn ratios. This residual scatter can now be taken as a real measure of the thickness of the emitting layer. It is now well established by direct rocket observations that this emission comes from two distinct layers in the Earth's upper atmosphere, one around 100 km and the other higher. Analysis made using the above three parameters and taking the height of the lower layer as 100 km shows that (i) the height for the upper emission layer is about 240 km and (ii) about 67% of the total observed intensity of this radiation at the ground comes from this upper layer. The ratio of the intensity of 6300 Å to that of 5577-Å radiation produced in this same layer comes out to be 3.3, in fair agreement with the Peterson theory which predicts a value of 4 for this ratio. (auth)

16093 INTERRELATION OF THE DIFFERENT NIGHT AIRGLOW EMISSIONS (5577 A, 5893 A, AND OH BANDS) IN THE LOWER IONOSPHERE. Rao, V. R.; Kulkarni, P. V. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 644-8(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

At Mt Abu (geogr. lat., 24.6°N; geogr. long., 72.7°E) airglow observations of 5577 Å, 5893 Å, and the two hydroxyl band OH (7-2) and OH (8-3) emissions have been regularly made since 1966. Their heights of emission are in the lower ionosphere. From the different excitation mechanisms proposed for these emissions, it is seen that atomic oxygen plays an important role in the time variations of these emissions. The interrelation of these emissions is studied from the observations. The effect of vertical eddy transport is also examined. (auth)

16094 PHOTOELECTRON IMPACT EXCITATION OF THE SECOND POSITIVE BANDS OF NITROGEN MOLECULE IN DAYGLOW. Sharma, V. N.; Singh, Dinesh; Singh, S. N.; Tolpadi, S. K. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 649-52(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The production rate of photoelectrons by solar xuv in the F region of the ionosphere is calculated. CIRA (1965) models 2, 5 and 8 (corresponding to low, medium, and high solar activity, respectively) have been used to determine the effect of solar activity by which only a change in number densities is assumed. The calculations are done only for the 1200 hrs local time $\chi = 0$. Considering various energy-dependent elastic and inelastic collision processes in slowing down the fast photoelectrons, equilibrium energy distribution for the photoelectrons is obtained in the F region of the ionosphere. Assuming the photoelectron impact excitation as the only possible mechanism for the population of the upper level ($C\ ^3\pi_u$), height profiles are obtained for the volume emission rate of some second positive bands of the nitrogen molecule ($v' = 0$, 1, and 2). The absolute cross section for the electron impact excitation measured by D. J. Burns et al. [J. Phys., B2: 52 (1969)] is used for all calculations. The variation of the intensity with the altitude is also presented and compared with the other intensity estimates made previously. (auth)

16095 PHOTOELECTRON EXCITATION OF THE DAYGLOW: MOLECULAR OXYGEN FIRST NEGATIVE AND SECOND NEGATIVE BANDS. Sharma, V. N.; Rai, D. K. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 653-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Equilibrium velocity distribution of the photoelectrons produced in the F region by solar ionizing radiations [A. Dalgarno et al., J. Atmos. Sci., 26: 753 (1969)] was used in conjunction with a CIRA (1965) model 2 atmosphere (1400 hrs) to yield the height dependence of volume emission rate. Two different intensity-height profiles were obtained for the molecular oxygen $b^4\Sigma_g^- \rightarrow a^4\pi_u$ first negative ($\lambda_{00} = 5998.31$ Å) band system, using on the one hand the volume density of molecular oxygen leading to the volume emission rates at different altitudes. The second method gives directly the intensity at an altitude, utilizing the column density of molecular oxygen. The results are compared with those of the previous studies. The estimate of the intensity for the second negative band system $A\ ^2\pi_u \rightarrow X\ ^2\pi_g$ ($\lambda_{00} = 2610.23$ Å) is also discussed. (auth)

16096 PARTICLE PRECIPITATION AND RANDOM MOVEMENTS OF IONIZATION IRREGULARITIES IN E REGION OF THE IONOSPHERE. Kaushika, N. D. (Delhi Univ.); Sharma, M. C. Indian J. Pure Appl. Phys.; 9: No. 8, 656-8(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The effect of magnetic latitude on the dispersion in drifts and the random movements of ionization irregularities in the E region of the ionosphere is studied. The results suggest that, at high latitudes, the random movements of the ionization irregularities may primarily be due to the dispersive wave motions caused by the precipitated particles in the ionosphere. (auth)

16097 IONOSPHERIC ABSORPTION MEASUREMENTS AT 2.2 MHz BY VERTICAL INCIDENCE PULSE SOUNDING METHOD

AT HYDERABAD. Rama Rao, K.; Rao, R. Sambasiva; Sarma, M. Satyanarayana (Defence Electronics Research Lab., Hyderabad). Indian J. Pure Appl. Phys.; 9: No. 8, 659-63(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Ionospheric absorption measurements by the vertical-incidence pulse-reflection technique made at Hyderabad (lat., 17°21'N; long., 78°28'E; geomag. lat., 07°39'N) at 2.2 MHz for the period April 1968–August 1970 are reported. The variation of absorption (L) with the solar zenith angle (X) is studied using the relation: $L = A \cos^n X$. The value of the index n is found to vary in the range 0.68 to 1.2 with an average of 0.97. The value of n for seasonal variation is found to be about 1.0. The monthly median noontime absorption shows peak values during vernal equinox months and minima during winter months. The normalized absorption values L_0 (reduced for R = 0 and X = 0) also indicate a month-to-month variation ranging from 30.0 to 40.0 db with an average value of 35.0 db. Large day-to-day variations are also observed in the noontime absorption values. These and the anomalies in the seasonal changes are discussed in the light of the warming of the stratosphere. The frequency-variation law is found to be more of the linear type than of an inverse-square-law type. (auth)

16098 IONOSPHERIC ABSORPTION AT DELHI. Setty, C. S. G. K.; Jain, A. R.; Kaur, Parvinder; Seera, G. S. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 664-7(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Radio-wave absorption on 5.7 MHz using the A1 technique was measured at the University of Delhi (geogr. lat., 28°38'N; geogr. long., 77°13 E; dip, 42.44°N). Regular diurnal and seasonal variations of absorption were found. Its dependence on sunspot numbers was also noted. Disturbed-day enhancements of absorption up to 20 db, presumably due to the effects of solar flares, were observed. The estimated normalized absorption on 2.2 MHz at vertical Sun and zero sunspot conditions is found to agree with the predicted value from the results of other stations. (auth)

16099 IONOSPHERIC ABSORPTION AT MID-LATITUDES IN WINTER. Patel, B. M.; Kotadia, K. M. (Gujarat Univ., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 668-72 (Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Ionospheric absorption data (A1 method) on 1.725 MHz at Freiburg are studied to examine the winter anomaly during the years 1963–65. It is observed that, although the average seasonal variations of ionospheric absorption and 10-mb-level temperature agree with each other, the day-to-day variability in these quantities does not show such agreement in all events of stratospheric warming, nor do the associated increases in absorption and the stratospheric temperature follow a linear relation. Further, the variability in absorption changes from one winter to another, in contrast to that seen in the 10-mb-level temperature. Moreover, the monthly mean value of absorption in winter is higher as a result of net larger increase on days of high absorption than decrease on days of low absorption. The approximate winter anomaly in absorption (L), which was highest in January 1964, is estimated at 166% above the value calculated by the relation $L = 35\ (1 + 0.0043\ \bar{R}z)\ \cos^{0.80} X$, $\bar{R}z$ being the Zürich average sunspot number and X the solar zenith angle. From some evidences available it is suggested that the changes in the gas composition and in the loss and production rates of ionization in the D region—and probably in the lower E region also—associated with some reversals in the normal seasonal wind circulation system at stratospheric levels may cause anomalous changes in the ionospheric absorption of hf radio waves during winter at midlatitudes. (auth)

16100 WORLDWIDE BEHAVIOR OF AVERAGE VHF–UHF SCINTILLATION. Fremouw, E. J.; Bates, H. F. (Stanford Research Inst., Menlo Park, Calif.). Radio Sci.; 6: No. 10, 863-9(Oct 1971).

A description of the latitudinal, diurnal, seasonal, and solar-cycle variations of F-layer-produced scintillations, based on a comprehensive review of the literature, is given. Three distinct latitudinal regimes are discussed in regard to scintillation behavior and the quantitative utility of observations reported in the literature. A semiquantitative empirical model is suggested to describe the strength of scintillation-producing irregularities of F-layer electron density. Recent work suggests that more quantitative modeling might now be fruitful, but gaps in fully quantitative data exist. The prime needs are for observations at very high latitudes and for calibration of scintillation indices used at very low latitudes. (auth)

16101 OBSERVED AND PREDICTED VLF PHASE BEHAVIOR FOR THE SOLAR ECLIPSES OF SEPTEMBER 11, 1969, AND MARCH 7, 1970. Noonkester, V. R.; Sailors, D. B. (Naval Electronics Lab. Center, San Diego, Calif.). Radio Sci.; 6: No. 10, 871-8(Oct 1971).

A vlf propagation and a D-region aeronomy model were used to predict the effect of two solar eclipses on vlf propagation to Aztec, Arizona. Transmissions at 12.2 kHz from Hawaii were monitored during the eclipse on September 11, 1969; and transmissions at 12.0 kHz from Trinidad, at 24 kHz from transmitter NBA, at 12.5 kHz from Forestport, New York, and at 17.8 kHz from transmitter NAA were monitored during the eclipse on March 7, 1970. The vlf phase predictions were found to agree with measurements except for the two nearly coincident northerly paths from Forestport and NAA. (auth)

16102 HEAVY-METAL-ION CLUSTERS. Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y.). Nature (London) Phys. Sci.; 234: No. 50, 129-30(13 Dec 1971).

The clustering of water vapor on lead ions is considered. Radioactive lead, as well as other major progeny ions of radon and thoron, is present in the troposphere and the upper atmosphere. The chemistry of these ions immediately after their formation from decay processes is important in determining their subsequent attachment to aerosols. This information is relevant in uranium mines and in the upper atmosphere where knowledge of their distribution leads to a better understanding of atmospheric mixing processes. Mass-spectrometric scans in the absence of a reacting gas showed the ion beam to be composed only of the isotopes of Pb^+. A wide variety of exploratory experiments were performed to ensure that equilibrium conditions were attained in the apparatus. Equilibrium constants, enthalpies and entropies of reaction, standard free energies of hydration and cluster concentration as a function of water vapor concentration were deduced or calculated. (UK)

Particle Kinetics and Trapping

Refer also to abstracts 16067, 16069–16071, and 16075.

16103 KINEMATIC REVERSAL SCHEMES FOR THE GEOMAGNETIC DIOPLE. Levy, Eugene H. (Univ. of Chicago). Astrophys. J.; 171: No. 3, 635-42(1 Feb 1972).

Fluctuations in the distribution of cyclonic convective cells, in the Earth's core, can reverse the sign of the geomagnetic field. Two kinematic reversal schemes are discussed. In the first scheme, a field maintained by cyclones concentrated at low latitude is reversed by a burst of cyclones at high latitude. Conversely, in the second scheme, a field maintained predominantly by cyclones in high latitudes is reversed by a fluctuation consisting of a burst of cyclonic convection at low latitude. The precise fluid motions which produce the geomagnetic field are not known. However, it appears that, whatever the details are, a fluctuation in the distribution of cyclonic cells over latitude can cause a geomagnetic reversal. (auth)

16104 EFFECTIVENESS OF CYLONIC CONVECTION FOR PRODUCING THE GEOMAGNETIC FIELD. Levy, Eugene H. (Univ. of Chicago). Astrophys. J.; 171: No. 3, 621-33(1 Feb 1972).

The dynamo equations for the production of astrophysical magnetic fields are solved for a spherical shell of shear and two axisymmetric rings of cyclonic convection cells. The infinite series arising in the stationary eigenvalue problem is converted to a definite integral which is evaluated numerically so that the convergence of the eigenvalue is explicit. The results of the calculations show that, for the fluid dynamics expected in the Earth's core, dipole-like fields can be maintained with any locations of the rings of cyclones, although convective cells at mid-latitudes are most efficient. Quadrupole-like fields are maintained only by high-latitude cyclones and generally require more vigorous fluid motions. (auth)

16105 MODULATION OF SPECTRUM AND AMPLITUDES OF LOW-FREQUENCY SIGNAL IN MAGNETOSPHERE PLASMA. Likhter, Ya. I.; Molchanov, O. A.; Chmyrev, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 8, 325-7(20 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 8, 475-9(20 Oct 1971).

An experiment was performed on the sounding of the magnetosphere by powerful low-frequency pulses with carrier frequency $f_0 = 15$ kHz. Such frequencies channel themselves in the magnetosphere plasma along the force lines of the Earth's magnetic field,

and the signals are received in a region that is magnetically conjugate to the transmitter. Two signals received were the waveguide signal passing over the Earth's surface in the Earth–ionosphere waveguide and the magnetosphere signal. The effects of periodic modulation of a quasi-noise spectrum of the magnetosphere signal and the associated amplitude modulation were observed. A characteristic fact is that the maxima of the spectrum broadening coincides with the maxima of the signal amplitude. Modulation of the quasi-noise spectrum and of the signal amplitude may be due to the presence of an intense extraneous ion-acoustic wave, particularly a quasi-monochromatic one in the corresponding regions of the magnetosphere. On the other hand, it is possible that the modulation is connected with the motion of resonant particles between mirror points in the geomagnetic field. The period of such a motion as estimated in the experiment (200 to 300 msec) is close to the period of the modulation. (J.C.W.)

16106 GEOMAGNETIC MICROPULSATION ACTIVITY AND ITS RELATION TO MAGNETOSPHERIC PROCESSES AND INTERPLANETARY MAGNETIC FIELD. Dhanju, M. S. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 493-7(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Using interplanetary-field parameters recorded aboard Explorer 28, the behavior of micropulsations in the period range of 10 to 120 sec in the telluric current activity recorded at College (Alaska), is investigated. The study is confined to ten geomagnetic storms occurring in the latter half of 1965. It is found that pulsations in the period range of 10 to 30 sec behave in a different manner compared to those in the period range of 30 to 120 sec. Detailed study in terms of the local time dependence of these two period ranges indicates that the observed activity can be explained by considering different magnetospheric processes taking place at a distance of about 5 to 6 Earth radii in the equatorial plane. Comparison of the particle observations by ATS-1 geostationary satellite with the pulsation activity supports this contention. (auth)

16107 PROPAGATION OF HYDROMAGNETIC WAVES IN A PARTIALLY IONIZED MAGNETOPLASMA. Nath, Omkar; Prasad, R. Y.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 561-3(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The dispersion relation for hydromagnetic waves propagating at an arbitrary angle through a partially ionized magnetoplasma is derived. The propagation characteristics are discussed for the longitudinal, transverse, and off-wave propagation. The effects of collision frequencies on the wave propagation are discussed. The analysis is extended to study the propagation of left- and right-hand circularly polarized hydromagnetic waves through the magnetospheric plasma. It is concluded that, near the ion gyrofrequency, the left-hand wave resonates with the ions and plays an important role in the propagation. (auth)

16108 TRAVELLING WAVE TUBE AMPLIFICATION OF HYDROMAGNETIC WHISTLERS IN THE MAGNETOSPHERE. Nath, Omkar; Prasad, R. Y.; Singh, R. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 586-9(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Amplification of hydromagnetic whistlers in the magnetosphere by a traveling-wave tube mechanism is considered. Expressions for the temporal growth rate and the subsequent amplification of the wave propagating at an arbitrary angle with the geomagnetic lines of force are derived in terms of two-component ambient plasma and one-component streaming plasma. It is concluded that the temporal growth rate increases with streaming charged-particle density, polar angle, frequency of the wave and McIlwain parameter, and decreases with the increase of latitude. (auth)

Solar Wind and Cosmic Ray Interactions

Refer also to abstracts 16003, 16028, 16074, 16101, and 16668.

16109 EFFECT OF NONUNIFORM SOLAR WIND VELOCITY ON INTERPLANETARY MEDIUM AND ON COSMIC RADIATION. Ananth, A. G.; Agrawal, S. P. (Physical Research Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 498-500(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The consequences of solar wind streaming with nonuniform velocity on the interplanetary medium are discussed. It is shown that the corotating shock fronts that produce the corotating Forbush decreases in the low-energy cosmic-ray intensity cause enhanced diurnal wave trains in the cosmic radiation at high energies. The enhanced diurnal variation in the initial stage is shown to be primarily due to a sink along the gardenhose direction which, after 3 to 4 days, results from an excess flux of cosmic rays from the anti-gardenhose direction. The latter finding is interpreted as a result of the positive density gradient in the cosmic-ray ion-density setup initially by the enhanced solar wind through convection process. (auth)

16110 SOLAR CYCLE VARIATION OF ELECTRON CONTENT OVER DELHI. Tyagi, Tuhi Ram; Mittal, Kamlesh Kumari (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 504-8(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The electron-content data from the analysis of the Faraday fading records of the satellites Explorer 22 and 27 (October 1964–March 1969 and June 1965–September 1967, respectively) were used to study the seasonal and solar-cycle variations of diurnal changes in electron content values (I). During solar minimum, the average diurnal maximum value (I_{max}) is 2.9×10^{17} m^{-2} and 1.5×10^{17} m^{-2} and average minimum (I_{min}) value is 0.24×10^{17} m^{-2} and 0.16×10^{17} m^{-2} for summer and winter, respectively. During solar maximum, the corresponding values are 4.4×10^{17} m^{-2}, 4.7×10^{17} m^{-2}, 0.96×10^{17} m^{-2}, and 0.32×10^{17} m^{-2}, respectively. The value of I_{max} during winter increases linearly with solar flux, but during summer the linear relationship is valid only up to about 150 units of flux and above this it shows saturation; further, the rate of increase is greater in winter than in summer. The value of I_{min} also shows a linear increase with solar flux both during summer and winter and the rate of increase is greater in summer than in winter. Seasonal anomaly appears only during daytime and only for high solar activity. The winter I_{max}/I_{min} ratio increases nonlinearly from about 7.5 for a solar flux of 70 units to about 12 for a flux of 220 units. For summer, it decreases regularly from 10 to about 2.5 as the flux increases from 70 to 220 units. The comparison of electron content measurements with C-4 ionograms shows that seasonal anomaly exists only in the topside of the ionosphere. This may be explained as due to the increase in the ratio of atomic to molecular number density of oxygen during winter. (auth)

16111 EFFECT OF PLANETARY MAGNETIC ACTIVITY ON COSMIC NOISE ABSORPTION MEASUREMENTS. Sharma, M. C.; Sarma, S. B. S. S. (National Physical Lab., New Delhi). Indian J. Pure Appl. Phys.; 9: No. 8, 553-5(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Though the association of cosmic-noise absorption with magnetic activity has been thoroughly investigated in high-latitude stations, there is not much information regarding the effect of planetary magnetic activity on cosmic-noise absorption measurements, especially at low and temperate latitudes. Giving adequate consideration to the possible significant time delay between increase in magnetic activity and an increase in cosmic-noise absorption, a detailed statistical study is undertaken to get the global pattern. To achieve this objective, noontime as well as nighttime cosmic-noise data were used to study the daytime and nighttime effects, respectively. (auth)

16112 POSSIBLE DECAY IN FLIGHT OF A NEW-TYPE PARTICLE. Niu, Kiyoshi (Tokyo Univ.); Mikumo, Eiko; Maeda, Yasuko. Progr. Theor. Phys. (Kyoto); 46: No. 5, 1644-6(Nov 1971).

A new type of emulsion chamber with local producing layer of jet shower was used to investigate superhigh-energy jet showers in full detail, combining information about secondary charged particles at or near an origin of jet showers as well as gamma rays. A possible decay in flight of a new type of particle was found, which is attributed to the X-particle two-body decay into a π^0 and a charged hadron. The properties of the new particle are indicated. (L.B.S.)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 15085, 16754, 16793, and 16808.

16113 MEASUREMENT OF SPUTTERED-PARTICLE VELOCITY SPECTRA. Cowell, G. K. (Univ. of California, Berkeley); Smith, Harold P. Jr. J. Appl. Phys.; 43: No. 2, 412-16(Feb 1972).

A time-of-flight technique was employed to determine the velocity distributions of particles sputtered from polycrystalline copper targets by a 1- to 5-keV pulsed Cs^+-ion beam. Velocity spectra were obtained for sputtered atoms having velocities greater than 2×10^6 cm/sec and for sputtered ions having velocities less than 3×10^6 cm/sec. In all cases, the target surface normal bisected the 64° angle between the detector and the incident ion beam, the target temperature was 20°C, and the flight path was 40 cm. Analytical models were fitted to the time-of-flight data. High-velocity emission was found to be described best by binary collisions at the target surface and low-velocity emission by Maxwellian distributions with temperatures predicted by C. H. Townes's theory of sputtering. It is proposed that the binary collisions (high-velocity particles) are responsible for preferred angular emission along close-packed crystallographic directions and that the low-velocity particles are responsible for the cosinusoidal component of the angular distribution. (auth)

16114 CHANGES IN THE FINE STRUCTURE OF THE ANGULAR DEPENDENCE OF THE SECONDARY ELECTRON EMISSION COEFFICIENT OF SINGLE CRYSTALS IN THE 2- TO 10-keV RANGE OF PRIMARY ELECTRON ENERGIES. Shul'man, A. R.; Korablev, V. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 15: No. 11, 2154-6(Nov 1970).

The emission coefficient σ as a function of incident angle φ was studied for Si, Nb, Mo, and W for primary electrons of 2- to 10-keV energies (E_p). With an increase in E_p, the amplitude of the fine structure in σ decreases, but this effect is less pronounced for higher atomic numbers. A similar effect was observed in the inelastic reflection coefficient η. (D.L.C.)

16115 CAPTURE OF POLARIZED ELECTRONS BY DEUTERONS EMERGING FROM A MAGNETIZED NICKEL FOIL. Brandt, W. (New York Univ., N. Y.); Sizmann, R. Phys. Lett.; 37A: No. 2, 115-16(8 Nov 1971).

The spin polarization observed by Kaminsky (Phys. Lett., 23: 819(1969)) in the neutrals of a deuteron beam emerging from a ferromagnetic single-crystal nickel foil is attributed to electrons captured in the tail of the surface electron distribution. (auth)

16116 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 6, NO. 11, 1971. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 61p.

This listing includes 190 articles on various aspects of surface and vacuum physics. (M.O.W.)

16117 CONDENSED PHASES IN CESIUM ADSORPTION THEORY. Warner, Charles (Atomics International, Canoga Park, Calif.). pp 414-21 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The LEED experiment of MacRae et al. (Surface Sci., 15: 483 (1969)) was originally interpreted as evidence for a cesium duolayer on W(100) at the work function minimum. This duolayer is controversial since it leads to coverages at the work function minimum that are approximately three times larger than those obtained in other experiments. The existence or nonexistence of the duolayer is very fundamental to understanding the work function minimum. A simple reinterpretation in terms of diffraction patterns of nonuniform structures, spot-splitting due to "out-of-phase" domains, and double diffraction is presented. It is concluded that all the experimental results can be explained in terms of a monolayer. (auth)

16118 INVESTIGATION OF THE ELECTRON WORK FUNCTION IN HIGH-MELTING TRANSITION-METAL SYSTEMS. Hauffler, G.; Goretzki, H. (Univ., Stuttgart. Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 422-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The interstitial incorporation of nonmetal atoms in a metal lattice causes a shifting of the electron work function. Dependent on the composition, systematic measurements of the work function were made with sintered samples of interstitial compounds of the transition metal systems Zr–O, Zr–C, Zr–B and Ta–O. Because these systems form large ranges of solubility or of homogeneous compounds, it is possible to show the pure influence of the interstitial atoms. The work function was measured using a pulsing voltage procedure with automatic data acquisition and evaluated by the method of Schottky–Richardson. The results show that the work function can be varied over wide ranges indicating strong interactions between the interstitial and metal atoms. (auth)

16119 ELLIPSOMETRY, AUGER SPECTROSCOPY, AND WORK FUNCTION OF Cs ON W AND Ti SINGLE CRYSTALS IN THE SUBMONOLAYER REGION. Smith, Tennyson (North American Rockwell Corp., Thousand Oaks, Calif.). pp 427-33 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

In order to study the thermodynamics, kinetics, and mechanisms for the interaction of Cs with a metal surface by ellipsometry, it becomes necessary to first prepare and maintain a clean surface, then monitor the adsorption as a function of such variables as reactant gas pressure and temperature. Interpretation of the ellipsometer results require measurement of the optical constants of the atomically clean metal substrate. Single crystals of W and Ti were cleaned in ultrahigh vacuum ($\sim 5 \times 10^{-10}$ torr) by Cs ion bombardment (also by Ar ion bombardment). The cleanliness of the surface is established by Auger spectroscopy which is capable of detecting and identifying ~0.05 monolayer of contamination within the first few atom layers of the surface. The optical constants of clean W and Ti were measured at 5461 Å. The deposition of Cs as a function of temperature was measured by ellipsometry, Cs ion current, and Auger spectroscopy. The work function change was also measured as a function of Cs surface concentration. (auth)

16120 INFLUENCE OF OXYGEN ADSORPTION AND OXYGEN–CESIUM CO-ADSORPTION ON (100) TUNGSTEN WORK FUNCTION. Alleau, Thierry; Bacal, Martha (CEN de Saclay, Gif-sur-Yvette, France). pp 434-40 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The effect of oxygen adsorption upon the (100) tungsten work function and the co-adsorption of oxygen and cesium were investigated in a thermionic electron emission microscope. Measurements of the desorption energy of oxygen from (100) tungsten were performed at constant oxygen coverage; it was found that this desorption energy is reduced when the oxygen coverage increases. The "S-curves" obtained when cesium and oxygen are co-adsorbed are presented. The effect of the oxygen additive was considerable. Several new current maxima appeared at low emitter temperatures; these maxima corresponded to work function values as low as 1 eV. The correlation curves "Φ vs T/T_c" exhibit transitions between the curves that correspond to substrate work functions 6 eV and 4.5 eV. The transition temperature increases with oxygen pressure. (auth)

16121 THEORETICAL DETERMINATION OF THE ENERGY DISTRIBUTION OF THE SECONDARY ELECTRONS EMITTED BY A DIELECTRIC MATERIAL. Duboulx, Pierre; Touzillier, Lucien; Scouarnec, Christian; Bandet, Jacqueline (Univ., Toulouse). Compt. Rend., Ser. B; 273: No. 16, 733-6(18 Oct 1971). (In French).

A Monte Carlo method was used to simulate the transport phenomenon of secondary electrons inside a magnesium oxide crystal. The theoretical curve for the electron energy distribution was subsequently deduced. (France)

Atomic and Molecular Properties

Refer also to abstracts 14817 and 16164.

16122 LASER-RAMAN SPECTRUM OF SOLID URANIUM HEXACHLORIDE. Shamir, J. (Hebrew Univ., Jerusalem); Silberstein, A. Spectrosc. Lett.; 4: No. 10-11, 341-2(Oct-Nov 1971).

The Raman spectrum of UCl_6 contained all three Raman active lines with O_h symmetry: ν_1, 369 cm^{-1}; ν_2, 325 cm^{-1}; and ν_5, 126 cm^{-1}. The results are compared with other data for WF_6 and WCl_6. (D.L.C.)

16123 MICROWAVE-OPTICAL DETERMINATION OF RYDBERG-STATE FINE STRUCTURE: THE 7^1D-7F INTERVALS IN ^4He. Wing, William H.; Lamb, Willis E. Jr. (Yale Univ., New Haven). Phys. Rev. Lett.; 28: No. 5, 265-8(31 Jan 1972).

The ^4He electrostatic fine-structure intervals $7^1D_2-7^1F_3$ and $7^1D_2-7^3F_3$ were measured near 31.5 GHz. The latter transition appears because of spin–orbit mixing of singlet and triplet 7F states of the same J. The 3-ppM precision represents a 10^4-fold improvement over the mean 7^1D-7F spectroscopic value. The mean 7F–7G and 7G–7H intervals were also measured. The microwave-optical method used appears widely applicable to atomic and molecular Rydberg states. (auth)

16124 CASCADING ANTICROSSINGS FROM n = 5 He^+. Beyer, H.-J.; Kleinpoppen, H.; Woolsey, J. M. (Univ. of Stirling, Scotland). Phys. Rev. Lett.; 28: No. 5, 263-5(31 Jan 1972).

Electric-field-induced anticrossing signals of n = 5 He^+ are detected by intensity changes of the line He II 4686 Å (n = 4 to n = 3). The fine-structure splittings $5^2S_{\frac{1}{2}}-5^2G_{\frac{1}{2}}$ and $5^2S_{\frac{1}{2}}-5^2G_{\frac{1}{2}}$ have been derived from the measurements to be 15 924.4 ± 5.9 and 17 040 ± 8.0 MHz, respectively, in agreement with the theoretical values of 15 920.0 and 17 043.6 MHz. The splitting $5^2G_{\frac{1}{2}}-5^2G_{\frac{1}{2}}$ is 1116.1 ± 14.0 MHz compared with the theoretical value of 1123.6 MHz. (auth)

16125 DIELECTRONIC RECOMBINATION OF HIGHLY CHARGED IONS. Bain, R. A.; Bardsley, J. N. (Univ. of Pittsburgh, Pa.). Phys. Lett.; 37A: No. 1, 75-6(25 Oct 1971).

Cross sections for dielectronic recombination of C^{5+}, O^{7+}, and Ne^{9+} are calculated. The results should be useful in calibration of experiments using beams of highly charged ions produced from Van de Graaff accelerators. (auth)

16126 SCCC–MO-CALCULATIONS ON THE IONS TcO_4^-, ReO_4^-, AND ReS_4^-. Kebabcioglu, R. (Univ., Dortmund, Ger.); Mueller, A.; Rittner, Walter. J. Mol. Struct.; 9: No. 1-2, 207-11(Jul 1971).

SCCC–MO calculations were extended to the anions TcO_4^-, ReO_4^-, and ReS_4^-, and tentative assignments of the electronic transitions were made. Group overlap integrals were calculated, taking into account the ligand–ligand overlap. The diagonal Hamiltonian elements were taken as the valence orbital ionization potentials. The off-diagonal elements were constructed according to the Yeranos approximation and the orbital energies, occupation numbers, and eigenvectors are tabulated for each anion. The charges and population analysis show the tendencies expected from electronegativity considerations. The first electronic transition was assigned to a one-electron $t_1 \rightarrow 2e$ ($^1A_1 \rightarrow {}^1T_2$) transition. The assignment of the first band ν_1 is $\pi(L) - d(M)$ charge transfer. (D.L.C.)

16127 SEPARATION OF MASS AND FIELD EFFECTS IN OPTICAL ISOTOPE SHIFTS. Baird, P. G.; Silver, J. D.; Stacey, D. N.; Stacey, V. (Clarendon Lab., Oxford). Phys. Lett.; 37A: No. 2, 100(8 Nov 1971).

A method (Epstein and Davis, Phys. Rev. A4: 4647(1971)) has recently been proposed for the separation of mass and field effects in optical spectral lines, using only optical data obtained for two such lines. This is demonstrated to be invalid. (auth)

16128 SCREENING EFFECTS IN OPTICAL ISOTOPE SHIFTS IN Ce IV, Sn IV, AND Cd II. King, W. H. (Univ. of Newcastle upon Tyne, Eng.); Wilson, M. Phys. Lett.; 37A: No. 2, 109-10(8 Nov 1971).

Hartree–Fock calculations of core-relaxation effects for the resonance s–p transitions in Ce IV, Sn IV, and Cd II yield the screening factors β_s = 1.095 for Ce IV, β_s = 1.066 for Sn IV, and β_s = 1.094 for Cd II. (auth)

16129 DETERMINATION OF THE $P_{\frac{1}{2}}-D_{\frac{1}{2}}$ SPLITTING AND DETECTION OF CROSSING SIGNALS IN THE n = 3 STATE OF IONIZED HELIUM. Eibofner, A. (Univ., Tuebingen, Ger.). Z. Phys.; 249: No. 1, 58-72(1971). (In German).

Radio-frequency-induced transitions between $3D_{\frac{1}{2}}$ and $3P_{\frac{1}{2}}$ Zeeman sublevels in He^+ were detected. From the position of the line center of the $D_{\frac{1}{2}}$ ($m = -\frac{1}{2}$)–$P_{\frac{1}{2}}$($m = \frac{1}{2}$) transition, the splittings $3D_{\frac{1}{2}}-3P_{\frac{1}{2}}$ = (17259 ± 13) MHz and $3P_{\frac{1}{2}}-3D_{\frac{1}{2}}$ = (81 ± 13) MHz were deduced. The theoretical values are 17254.9 and 85.4 MHz. Three crossings of Zeeman sublevels of the 3S, 3P, and 3D states of He^+ were detected both by a magnetic and an electric field modulation method. The crossing-field strengths are in good agreement with the calculated values. (auth)

16130 DETERMINATION OF THE LIFETIME OF THE 3P STATE OF IONIZED HELIUM FROM THE HALF-WIDTHS OF RADIO-FREQUENCY SIGNALS. Eibofner, A. (Univ., Tuebingen, Ger.). Z. Phys.; 249: No. 1, 73-7(1971). (In German).

The dependence of the half-widths of $3S_{\frac{1}{2}}(m = -\frac{1}{2}) \rightleftharpoons 3P_{\frac{1}{2}}(m = \frac{1}{2})$ transition signals in ionized helium on rf power was measured. By linear extrapolation of the squared half-widths towards zero power, a value of τ_{3P} = (0.324 ± 0.011) ns for the lifetime of the 3P state was deduced (theoretical value 0.329 ns). (auth)

16131 EXPERIMENT ON HYDROGEN AND DEUTERIUM FINE STRUCTURE. Pollack, Sanford P.; Wong, Eugene Y. (Univ. of California, Los Angeles). Amer. J. Phys.; 39: No. 11, 1386-7(Nov 1971).

The experimental apparatus is described in detail. Photographs of D_α and H_α using different discharge tubes are presented and discussed. (M.O.W.)

16132 TRANSITION PROBABILITIES AND RADIAL OVERLAP FOR THE HYDROGEN ATOM AND THE ALGEBRA OF O(3,2). Herrick, D.;Sinanoglu, O. (Yale Univ., New Haven). Chem. Phys. Lett.; 12: No. 2, 310-11(15 Dec 1971).

The transition probabilities of the nonrelativistic hydrogen atom are related to radial-function overlap using the Lie algebra generators of O(3,2). (auth)

16133 GAUSSIAN ORBITALS IN CALCULATIONS OF THE SECOND-ORDER CORRECTIONS TO THE INTERACTION ENERGY OF TWO HYDROGEN ATOMS. Chalasinski, G.; Kolos, W.; Petelenz, B.; Piela, L. (Univ., Warsaw). Chem. Phys. Lett.; 12: No. 2, 233-5(15 Dec 1971).

The second-order correction to the interaction energy of two ground-state hydrogen atoms was calculated by expanding $\psi^{(1)}$ in terms of products of the gaussian orbitals. Satisfactory convergence was obtained in both the no-overlap and small-overlap regions. Asymptotic values of the nonlinear parameters were shown to give a rapid convergence in the region of small overlap. (auth)

16134 INTERATOMIC CORRELATION ENERGY AND THE VAN DER WAALS ATTRACTION BETWEEN TWO HELIUM ATOMS. McLaughlin, D. R. (Univ. of New Mexico, Albuquerque, Univ. of California, Livermore); Schaefer III, H. F. Chem. Phys. Lett.; 12: No. 2, 244-8(15 Dec 1971).

A priori calculations were carried out on He–He for 26 internuclear separations between 3.0 and 10.0 bohrs. The interatomic correlation energy is added to the Hartree–Fock energy to predict a potential energy curve. The calculated potential parameters are ϵ = 12.02°K, σ = 2.608 Å, R_e = 2.944 Å. Predicted values of the coefficients C_6 and C_8 are within 7% and 3% of the accepted values. The interatomic correlation energy is divided into contributions from atomic and molecular orbitals of different symmetry types. (auth)

16135 INVESTIGATION OF AUGER PROCESSES BY MEANS OF GAMMA RESONANCE SCATTERING BY NUCLEI. Dautov, L. M.; Kaipov, D. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 1-6(Mar-Apr 1971). (In Russian).

A molecule is converted into a system of positively charged ions flying in all directions under the influence of Coulomb repulsion if one of its atoms is a participant in the Auger process. This fact is utilized for regenerating the conditions of γ resonance absorption by nuclei. The distribution of the Auger-induced charges may be obtained from the resonance cross section of γ scattering. (tr-auth)

16136 BRANCH POINT SINGULARITIES IN THE ENERGY OF THE DELTA-FUNCTION MODEL OF ONE-ELECTRON DIATOMS. Certain, P. R.; Byers Brown, W. (Univ. of Manchester, Eng. Univ. of Wisconsin, Madison). Int. J. Quant. Chem.; 6: No. 1, 131-42(Jan 1972).

Two different perturbation series (the polarization expansion and a united-atom expansion) of the ground-state energy of the delta-function model for one-electron diatoms are studied, and the radii of convergence are determined. For both expansions the singularity in the energy that limits the radius of convergence is a branch point with exponent one-half. The physical sig-

nificance of the branch point is that for particular values of the perturbation parameter, two different energy eigenvalues coalesce. The positions of the branch points are computed as a function of the internuclear separation R. For all values of R, both series converge for all physical values of the perturbation parameters. A lower bound to the radius of convergence of the polarization expansion has been computed previously by Claverie. It is proved in the present paper that the lower-bound calculation is in fact an exact determination of the radius of convergence. The results of the model study are applied to real one-electron diatoms to suggest the possible location of a branch point singularity in the energy of the ground state.

16137 VARIATIONAL CALCULATION OF ASYMPTOTIC VALUES OF THE QUANTUM DEFECT FOR HELIUM. Ariyama, Masataka (Univ. of Electro-Communications, Tokyo); Mizuno, Yukio; Sanematu, Tosio. J. Phys. Soc. Jap.; 32: No. 2, 500-5 (Feb 1972).

For the ^1S and ^3S Rydberg series of helium, Smith's Hartree–Fock-type variational calculation of the asymptotic values of the quantum defect, Δ_∞, is improved by adding only a few configurational wave functions of analytic form to the primary Hartree–Fock-type wave function. The best values of nonlinear parameters in the added configurational wave functions are chosen on the basis of the minimum principle for Δ_∞, which is here rederived straightforwardly from a well-known theorem on the Rayleigh–Ritz variational treatment. The integer parts of Δ_∞'s, which have been left indefinite in all the calculations by predecessors, are determined theoretically with the help of another inequality relation, which is also a direct consequence of the same theorem. (auth)

16138 POTENTIAL ENERGY SURFACES. Krauss, M. (National Bureau of Standards, Washington, D. C.). Annu. Rev. Phys. Chem.; 21: 39-46(1970).

Ab initio energy surfaces applicable to chemical kinetics and collisional phenomena are reviewed. The calculations are divided into two categories, Hartree–Fock and beyond. It is noted that Hartree–Fock calculations are routine but that correlation techniques are necessary for reactive collisions. Definitive work exists for H_3^+ and H_4, but the activation energy of H_3 is still inaccurate relative to the scattering calculational requirements. Other qualitative work is described for H or Li interaction with diatomics. (70 references) (auth)

16139 NEW DIRECTIONS IN ATOMIC PHYSICS. VOLUME II. EXPERIMENT. Condon, Edward U.; Sinanoglu, Oktay (eds.). Yale Series in the Sciences. New Haven; Yale University Press (1972). 175p. $7.50.

Eight papers by different authors are included. The titles are as follows: Principles of Optical Pumping (Part 1, Nonthermal Distributions in Atomic States; Part 2, Magnetic Resonance and Magnetic Moments); Virtual Transitions in Atomic Spectroscopy; The Franck–Condon Principle and Very Small Magnetic Fields; Atomic and Molecular Beam Experiments; Recent Developments in Atomic Beams; Atomic Physics in Astrophysics; Atomic Transition Probabilities—New Experimental and Theoretical Results and Their Comparison. (A.G.W.)

16140 EXPERIMENTAL INVESTIGATION OF M-SUBSHELL FLUORESCENCE YIELDS AND OF THE L_1-L_3 RADIATIVE TRANSITION IN NEPTUNIUM AND CURIUM FROM THE RADIOACTIVE DECAYS OF ^{241}Am AND ^{249}Cf. Karttunen, Esko Ilmari. Atlanta; Georgia Inst. of Tech. (1971). 146p. University Microfilms Order No. 71-19,338.

Thesis.

The construction and performance of a wall-less multiwire proportional counter (MWPC) is described. The measured and calculated efficiencies are compared, and possible reasons for observed discrepancies are discussed. The absolute emission rate of M x rays from an ^{241}Am source was measured with the MWPC and with a single-wire proportional counter and a value of $(6.35 \pm 0.60) \times 10^{-2}$ M x rays per decay, or (0.0470 ± 0.045) M x rays per L_α x ray is obtained. High resolution Ge(Li) and Si(Li) x-ray spectrometers and the multiwire proportional counter (MWPC) were used for measuring coincidences, respectively, between various L x rays and the M x rays of neptunium (Z = 93) from a ^{241}Am source. In addition, M x rays of curium from a ^{249}Cf source were measured with a Si(Li) detector in coincidence with various K and L x rays detected with a Ge(Li) spectrometer. Coincidence rates were corrected both experimentally and on the basis of calculation for the effect of multiple M-shell vacancies. Expressions for quantitative calculation of this correction are derived. High resolution in the detection of L and K x-ray spectra permits determination of most of the mean M-subshell fluorescence yields of Np and Cm. Observation of the radiative L_1-L_3 transition was made for the first time in the high-Z region. Its intensity is compared to the total intensity of the L_3 and L_1 x rays, and reasonable agreement with the theoretical predictions is obtained. The radiative fraction ω_{13}^r in the Coster–Kronig yield f_{13}^r is found to be about 5% in the region Z = 93–96: $\omega_{13}^r = (0.030 \pm 0.014)$ at Z = 93 and (0.028 ± 0.020) at Z = 96. (TSS) (Diss. Abstr. Int., B)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 14961 and 16833.

16141 KRYPTON-INDUCED PRESSURE SHIFT IN THE ELECTRONIC GYROMAGNETIC RATIO OF MUONIUM. Jarecki, J.; Herman, R. M. (Pennsylvania State Univ., University Park). Phys. Rev. Lett.; 28: No. 4, 199-202(24 Jan 1972).

The fractional shift in the electronic gryomagnetic ratio in muonium is calculated as -7.8 ± 2.3 ppM under Kr pressure of 230 psi at 30°C. By combining this with the experimental data of The University of Chicago Group, the values $\mu_e/\mu_\mu = 206.766\ 70(93)$ for the electron to muon magnetic moment ratio, $\mu_\mu/\mu_p = 3.183\ 349$ (15) for the muon to proton magnetic moment ratio, $m_\mu/m_e = 206.767\ 96(95)$ for the muon to electron mass ratio, and $\alpha^{-1} = 137.036\ 46(36)$ for the inverse fine-structure constant were obtained. (auth)

16142 INFLUENCE OF THE PION FORM FACTOR ON ENERGY LEVELS IN PIONIC ATOMS. Schroeder, U. E. (Univ., Karlsruhe, Ger.). Acta Phys. Austr.; 32: No. 3-4, 299-302 (Mar 1970).

It is found that because of the pion form factor the s and p levels are shifted by amounts in the range $4 \leq \Delta E \leq 200$ eV. For higher angular momentum levels this effect becomes too small to be seen with present experimental accuracy. (auth)

16143 CHEMISTRY OF NEW ATOMS. Goldanskii, V. I.; Firsov, V. G. (Inst. of Chemical Physics, Moscow. Inst. of Theoretical and Experimental Physics, Moscow). Annu. Rev. Phys. Chem.; 22: 209-58(1971).

The chemistry of atoms in which either an electron is replaced by another negative charged particle or the proton by another positively charged particle is reviewed. A section on positronium covers the following topics: characteristics of positron annihilation and the physical properties of positronium, chemical properties of positronium, probability of positronium formation and its inhibition processes, experimental techniques in positronium chemistry, information of chemical significance obtained in positron annihilation experiments, and specific features of positron annihilation in porous media. In a section on muonium the following are discussed: nuclear physical characteristics of the μ^+ meson and muonium, physicochemical principles of muonium interaction, reactions of muonium with unsaturated compounds, and other types of muonium interaction. Effects observed while investigating the effect of chemical structure on the atomic capture of μ^- and π^- mesons in different media are reviewed briefly. 124 references. (A.G.W.)

Collision Phenomena

Refer also to abstracts 14957, 16138, 16171, 16634, and 16673.

16144 (COO-3069-1) CHARGE STATES AND CHARGE CHANGING CROSS SECTIONS OF FAST HEAVY IONS PENETRATING THROUGH GASEOUS AND SOLID MEDIA. Betz, Hans-Dieter (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). 1970. Contract AT(11-1)-3069. 283p. (DSR-77903). Dep. NTIS.

The experimental and theoretical situations concerning charge states and charge-changing cross sections of heavy ions with atomic numbers primarily between 18 and 92, inclusive, which penetrate through gaseous and solid targets with velocities in the range $v_0 < v < Zv_0$ ($v_0 = e^2/\hbar = 2.188 \times 10^8$ cm/s), are reviewed. The published literature is covered through August 1971. General physical and mathematical relations are outlined which describe the composition of charge states in a heavy-ion beam that passes through matter. Recent experimental techniques and methods of data analysis are summarized. Extensive experimental results on heavy-ion equilibrium charge-state distributions, average equilibrium charge states, and cross sections for capture and loss of one or more electrons in single encounters with target atoms are presented and critically examined in detail. The data extend to ions as heavy as uranium and energies up to ~200 MeV.

Systematic trends are emphasized, and generalizations that allow interpolations and to some extent extrapolations of the data to be made to ranges not investigated experimentally are discussed. Attention is given to the cross sections for multiple electron loss, which are relatively large but which are poorly understood. Effects of residual ion excitation on charge-changing collisions are considered in the light of recent experimental results. It is shown that the average equilibrium charge of heavy ions can be approximated by utilizing both theoretical concepts originating from the work of Bohr and Lamb and semi-empirical relations based on observed regularities of the data. Recent interpretations of phenomena associated with density effects, i.e., with the increase of projectile ionization observed for increasing target densities, are scrutinized, and refinements of the theory by Bohr and Lindhard are explored. (61 figures, 5 tables, 154 references) (auth)

16145 (LBL-394) COLLISIONAL PRODUCTION AND LOSS OF 1- TO 42-keV/NUCLEON $X^1\Sigma_g^+$ AND $c^3\Pi_u$ HYDROGEN MOLECULES, AND APPLICATION TO CONTROLLED NUCLEAR FUSION. Morgan, Thomas Joseph (California Univ., Berkeley. Lawrence Berkeley Lab.). Sep 1971. Contract W-7405-eng-48. 150p. Dep. NTIS.

Thesis.

As part of a study to devise new and more efficient schemes for injecting fast neutral particles into plasma fusion devices, collisions were investigated which result in the formation and destruction of the $(1s\sigma^2)X^1\Sigma_g^+$ ground state [$1 \leq E$ (keV/nucleon) ≤ 42] and the $(1s\sigma 2p\pi)c^3\Pi_u$ long-lived electronically excited state [$5 \leq E$(keV/nucleon) ≤ 42] of molecular hydrogen. The $c^3\Pi_u$ molecules were formed by electron capture by 5- to 42-keV/nucleon H_2^+ ions in Mg vapor. The molecules and atoms were detected by particle-counting techniques, using CsI(Tl) scintillation crystals mounted on photomultipliers, with the resulting signal being amplified and shaped, pulse-height analyzed, and scaled. (M.O.W.)

16146 STRONG, QUASIPERIODIC DEPENDENCE OF AUTOIONIZATION SHAPE PARAMETERS ON PROJECTILE ENERGY IN H^+ + He COLLISIONS. Schowengerdt, F. D.; Rudd, M. E. (Univ. of Nebraska, Lincoln). Phys. Rev. Lett.; 28: No. 3, 127-30(17 Jan 1972).

Profiles of the $2s^2$ (^1S) autoionizing state in He were observed in the ejected-electron spectrum of H^+ + He for small angles of ejection and for H^+ energies of 6 to 150 keV. The shape parameter q shows an increasing dependence on projectile energy as the angle of ejection is decreased, with strong, quasi-periodic oscillations appearing at 10°. (auth)

16147 APPLICATION OF THE ADIABATIC-NUCLEI THEORY TO VIBRATIONAL EXCITATION. Faisal, F. H. M.; Temkin, A. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Lett.; 28: No. 4, 203-6(24 Jan 1972).

The adiabatic-nuclei theory is shown to be quantitatively applicable to vibrational excitation of diatomic molecules by electron impact. When the dependence of the fixed-nuclei phase shifts on internuclear separation is approximated by a two-term Taylor series, the resulting formulas are transparent and easily evaluated. Application to $e-H_2$ excitation is made, phase-shift derivatives are estimated, and the theory is found to fit experimental data. (auth)

16148 INELASTIC SCATTERING OF ELECTRONS BY MOLECULES WITH THE RENNER EFFECT. Kiselev, A. A.; Ob'edkov, V. D.; Yurova, I. Yu. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1835-40(Nov 1971). (In Russian).

The problem of excitation of vibrational states in triatomic linear molecules with the Renner effect is considered in the Born approximation. The problem of similar excitation of molecular ions is considered in the Born–Coulomb approximation. A "direct" nonresonance mechanism of molecule excitation is assumed. It is found that scattering cross section maxima corresponding to excitation of the first three Renner states should be observable in the electron inelastic scattering energy loss spectrum. This should permit one to investigate the Renner effect in collision spectroscopy. (auth)

16149 IONIZATION OF ATOMIC HYDROGEN BY ELECTRON IMPACT. NUMERICAL CALCULATIONS FOR THE FREE-FALL ATOMIC MODEL. Gryzinski, M. (Inst. of Nuclear Research, Swierk, Poland); Kunc, J.; Zgorzelski, M. Phys. Lett.; 38A: No. No. 1, 35-6(3 Jan 1972).

The atomic model of the zero-angular-momentum electron trajectory was used in numerical classical three-body calculations of hydrogen-atom ionization by electron impact. The results are compared with the results for the microcanonical model and with experimental data. (auth)

16150 RESOLUTION IN THE TOTAL AND DIFFERENTIAL SCATTERING CROSS SECTION MEASUREMENTS WITH ATOMIC BEAMS. Kalinin, A. P.; Leonas, V. B.; Sermyagin, A. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 12: No. 3, 245-51(May-Jun 1971). (In Russian).

Resolution capability in total and differential cross section measurements was studied while using atomic and molecular beams of finite geometry. Calculations were conducted to obtain the instrumental function $f(\Theta)$ which in turn was used to interpret the cross section measurements. (tr-auth)

16151 UNITARIZED BORN APPROXIMATIONS. Bandrauk, A. D. (Univ. of Sherbrooke, Quebec). Chem. Phys. Lett.; 12: No. 2, 253-8(15 Dec 1971).

Unitarized Born and distorted-wave Born (DWB) approximations are shown to be equivalent to pole approximations of the infinite-order perturbation series. A correction to the unitarized approximation is derived and estimated for the exponential potential. (auth)

16152 METHOD FOR THE MEASUREMENT OF THE ELECTRON-IMPACT EXCITATION CROSS SECTION OF ARGON. Winicur, D. H. (Univ. of Notre Dame, Ind.); Knuth, E. L. Chem. Phys. Lett.; 12: No. 2, 261-3(15 Dec 1971).

A method is described for the measurement of absolute values of the total electron-impact excitation cross sections of argon to metastable states (^3P). The method utilizes measurements of the ratio of excitation to ionization cross sections. Results are reported from 60 to 100 eV. (auth)

16153 ABSOLUTE CROSS SECTION FOR THE PRODUCTION OF $O(^5S^0)$ BY ELECTRON IMPACT DISSOCIATION OF O_2. Wells, W. C.; Borst, W. L.; Zipf, E. C. (Univ. of Pittsburgh). Chem. Phys. Lett.; 12: No. 2, 288-90(15 Dec 1971).

An estimate of the cross section for the production of $O(^5S^0)$ by electron-impact dissociation of O_2 was made based on the recently published work of several groups. The cross section reaches a maximum value of 7×10^{-18} cm^2 ± 50% at about 100 eV. The assumptions made in arriving at this cross section suggest several experiments that might be performed to further refine this estimate. (auth)

16154 VIBRATIONAL AND ROTATIONAL EXCITATION IN $He(2^3S_1)$ PENNING IONIZATION: EXAMPLES OF NONVERTICAL PROCESSES. Richardson, W. C. (Kansas State Univ., Manhattan); Setser, D. W.; Albritton, D. L.; Schmeltekopf, A. L. Chem. Phys. Lett.; 12: No. 2, 349-51(15 Dec 1971).

The production of the $O_2^+(A^2\Pi_u)$, $HBr^+(A^2\Sigma^+)$, and $HCl^+(A^2\Sigma^+)$ states from Penning ionization by $He(2^3S_1)$ metastables was observed to be a nonvertical process. The $O_2^+(A^2\Pi_u)$ state shows high rotational excitation. (auth)

16155 ENERGY SPECTRA OF ELECTRONS EJECTED IN ION–ATOM COLLISIONS. Ogurtsov, Gennadi N. (Ioffe Inst. of Physics and Tech., Leningrad). Rev. Mod. Phys.; 44: No. 1, 1-17(Jan 1972).

The available experimental data on energy spectra of electrons ejected in ion–atom collisions are reviewed against the background of modern theoretical concepts. 67 references. (auth)

16156 ELECTRON IMPACT. Dillon, Machael A. (Carnegie-Mellon Univ., Pittsburgh). pp 375-427 of Creation and Detection of the Excited State. Vol. I, Pt. B. /Lamola, Angelo A. (ed.). New York; Marcel Dekker, Inc. (1971).

Collision processes in which an excited state of an atom or molecule is produced by impact with electrons are discussed. Experimental methods for study of the excited state resulting from the collision are reviewed. These include the energy-loss method, the trapped-electron method, the electron-scavenger method, and the ejected-electron method. Some fundamental concepts of collision processes are described, and these are compared with experimental results. 100 references. (A.G.W.)

16157 HIGH-RESOLUTION MEASUREMENT OF OPTICAL EXCITATION FUNCTIONS OF HELIUM AND NEON. Kisker, E. (Univ., Hamburg). Phys. Lett.; 38A: No. 2, 79-80(17 Jan 1972).

Some excitation functions of He and Ne were measured near threshold by detecting the photons emitted by the levels excited by electron impact. The excitation functions of the 3889- and 3188-Å lines of He and the 5852-Å line of Ne are reported. (A.G.W.)

16158 MEASUREMENTS OF TOTAL CROSS SECTIONS FOR THE SCATTERING OF POTASSIUM ATOMS BY RARE GASES.

Kusunoki, Isao (Kyoto Univ.). Bull. Chem. Soc. Jap.; 44: No. 8, 2067-74(Aug 1971).

Total cross sections for the scattering of potassium by He, Ne, Ar, Kr, and Xe were measured in the thermal-energy range. The velocity of the potassium beam is selected by a velocity selector of a slotted-disk type. To obtain accurate total cross sections, the pumping effect of a McLeod gage for the pressure measurements, the fringe effect of the scattering chamber, and corrections for angular resolution and for thermal motion of the target gases are taken into consideration. A new type of scattering chamber with a variable length is used to eliminate the error of the effective scattering path length. The velocity dependence of total cross sections was obtained and glory undulations were observed for potassium–xenon systems. For argon, krypton, and xenon the van der Waals constants are calculated from the absolute total cross sections. The values of C_{K-Ar}, C_{K-Kr}, and C_{K-Xe} are 237, 354, and 535×10^{-60} erg · cm^6, respectively, and are in good agreement with the theoretical ones of Dalgarno and Davison. For neon the velocity dependence of the total cross section can not be explained by the van der Waals potential, $-C/r^s$, where $s = 6$. For helium the correction factors for thermal motion of the scattering gas are large and the value of s for an attractive potential can not be determined unambiguously. (auth)

16159 DETERMINATION OF EFFECTIVE CROSS SECTIONS FOR THE EXCITATION OF THE $4\,^3P_{0,1,2}$ ZINC ATOM LEVELS BY ELECTRON IMPACT. Penkin, N. P.; Redko, T. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 30: No. 2, 194-5(Feb 1971).

Translated from Opt. Spektrosk.; 30: No. 2, 359-61(Feb 1971).

The positive column of a discharge in Zn in the vapor-pressure range 3 to 8×10^{-2} mm Hg was used to determine the effective cross sections for excitation of the $4^3P_{0,1,2}$ levels by electron impact. Mean values of $Q(V_{max})$ found for the three levels are 1.5×10^{-16} cm^2 for $^3P_2$, 1.0×10^{-16} cm^2 for $^3P_1$, and 0.5×10^{-16} cm^2 for $^3P_0$. The accuracy of the values is estimated to be 60 to 70%. (A.G.W.)

16160 ATOMIC REARRANGEMENT COLLISIONS IN THE EIKONAL APPROXIMATION. Byron, F. W. Jr. (Univ. of Massachusetts, Amherst).; Joachain, C. J. Phys. Lett.; 38A: No. 3, 185-6(31 Jan 1972).

The many-body eikonal approximation is applied to the collision $e^- + He(1^1S) \rightarrow e^- + He(2^3S)$. Good agreement is found with recent absolute experimental data. (auth)

16161 INNER-SHELL IONIZATION OF COPPER, SILVER, AND GOLD BY ELECTRON BOMBARDMENT. Davis, D. V.; Mistry, V. D.; Quarles, C. A. (Texas Christian Univ., Fort Worth). Phys. Lett.; 38A: No. 3, 169-70(31 Jan 1972).

Total K-shell ionization cross sections by electron bombardment were measured for copper, silver, and gold at various energies up to 140 keV. Total L_{III}-shell ionization cross sections were also measured for gold. (auth)

16162 ELASTIC SCATTERING OF ELECTRONS FROM LITHIUM. Tripathi, A. N.; Mathur, K. C.; Joshi, S. K. (Univ. of Roorkee, India). Phys. Lett.; 38A: No. 3, 159-60(31 Jan 1972).

The elastic scattering of electron by lithium was calculated using the polarized Born approximation. The polarization potential is obtained following the procedure of Stone. The exchange is included via the Ochkur approximation. The results for the total elastic-scattering cross section are compared with other calculations and with experimental data. (auth)

Atomic Theory

Refer also to abstract 16851.

16163 VECTOR-COUPLING COEFFICIENTS FOR $s^l p^m d^n f^q$ CONFIGURATIONS. Oakland, R. L. (Texas Christian Univ., Fort Worth). Phys. Lett.; 38A: No. 1, 33-4(3 Jan 1972).

A computer program was written to generate vector-coupling coefficients for any electron configuration consisting of any combination of s, p, d, and f open shells. The results are useful for atomic self-consistent-field calculations. (auth)

16164 APPLICATION OF THE RAYLEIGH–SCHROEDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. Montgomery, H. E.; Bruner, B. L.; Knight, R. E. (Univ. of Kentucky, Lexington). Chem. Phys. Lett.; 12: No. 2, 236-7(15 Dec 1971).

Rayleigh–Schroedinger variational perturbation theory is applied to the hydrogen-like atom with a perturbation proportional to 1/r. It is rigorously shown that the exact eigenfunction is obtained by direct summation of the perturbation expansion through infinite order. (auth)

16165 ELECTRON DENSITY OF NONALKALINE ATOMS IN THE REGION OF THE NUCLEUS FROM THE FERMI–SEGRE–GOUDSMIT FORMULA. Dautov, L. M.; Kadykenov, M. M.; Daipov, D. K.; Ionov, S. P. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 6-13(Mar-Apr 1971). (In Russian).

The Fermi–Segre–Goudsmit formula is found to be applicable under certain conditions to the estimation of the contribution of the aggregate of valence electrons to the total density of the electron shell near the nucleus $\rho(0)$. In the isotope ^{119}Sn, the formula leads to a qualitatively correct interpretation of isomer shifts in the Moessbauer spectra with Slater's parameters, and to an incorrect one with Urucov's parameters. The results obtained agree with experimental data and with findings from the Hartree–Fock method. (5 tables). (tr-auth)

16166 DETERMINATION OF RADIAL ELECTRON–ELECTRON DISTRIBUTION FUNCTIONS. Benesch, Robert (Univ. of Waterloo, Ont.). Int. J. Quant. Chem.; 6: No. 1, 181-92 (Jan 1972).

The problem of evaluating the radial electron–electron distribution function $P_0(r_{12})$ from the spin-free 2-particle density matrix $P^{(2)}(r_1,r_2|r_1',r_2')$ is considered in detail. The analysis is first applied to 2-electron S-type functions built from 1^2 configurations. For the special case $l = 0$, the expression for $P_0(r_{12})$ reduces to the result obtained by Coulson and Neilson. For nonspherically symmetric states of N-electron atoms, the angular integrations are handled by a procedure used by Calais and Löwdin in their evaluation of atomic integrals containing functions of r_{12}. Consideration is also given to the evaluation of necessary radial integrals. (auth)

16167 THEORY OF ELECTRON CORRELATION IN ATOMS AND MOLECULES. II. GENERAL CLUSTER EXPANSION THEORY AND THE GENERAL CORRELATED WAVE FUNCTIONS METHOD. Roby, Keith R. (Australian National Univ., Canberra). Int. J. Quant. Chem.; 6: No. 1, 101-23(Jan 1972).

An exact cluster expansion of many-electron wave functions is derived, beginning with a finite linear combination of Slater determinants rather than the more usual single determinant. This general cluster expansion is found to apply both in the case where all possible Slater determinants from a finite set of spin orbitals are included in the linear combination and in the case where the number of determinants is restricted. The special properties of that finite linear combination of determinants closest to the exact wave function in the least squares sense are studied. These properties lead to the derivation of a general correlated wave functions method, illustrating again the close relationship between methods of this type and cluster expansion theory. Additional approximations, necessary for practical calculations, are set out. (auth)

16168 SPIN-FORBIDDEN TRANSITIONS IN ATOMS. Shepard, W. N. (Univ. of Arizona, Tucson). Amer. J. Phys.; 40: No. 2, 339-40(Feb 1972).

The fact that spin-forbidden transition probabilities can be enhanced by a magnetic field is discussed theoretically. An expression is derived for the ratio of transition probabilities with and without a magnetic field. The possibility of observing normally unobservable spin-forbidden transitions under suitable magnetic fields is suggested. (A.G.W.)

16169 MATRIX ELEMENTS OF THE QUADRATIC STARK EFFECT ON ATOMS WITH HYPERFINE STRUCTURE. Schmieder, Robert W. (Univ. of California, Berkeley). Amer. J. Phys.; 40: No. 2, 297-311(Feb 1972).

The perturbation of atomic hyperfine levels by a weak uniform static electric field is discussed. For nearly all atoms, the effects linear in the field are identically zero, and the levels suffer small shifts proportional to the square of the field. The calculation of these shifts using ordinary second-order time-independent perturbation theory is presented. The advantages of separating the interaction into kinematical and dynamical parts and techniques for performing the separation are discussed. The algebra of irreducible spherical tensors is used to separate the interaction into parts having monopolar and quadrupolar symmetry. Some numerical values of the matrix elements of the quadrupole part are given (the monopole elements are trivial), and the shifts of the hyperfine levels due to this interaction are plotted as a function of field for some typical atoms. (auth)

16170 REDUCED COULOMB–GREEN FUNCTION FOR THE RADIAL SCHROEDINGER EQUATION. Sherstyuk, A. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 30: No. 2, 191-3(Feb 1971).

Translated from Opt. Spektrosk.; 30: No. 2, 356-7(Feb 1971).

An expression for the reduced Coulomb Green function for cal-

culating atomic states with arbitrary values of the principal quantum number n and azimuthal quantum number l is derived. (A.G.W.)

16171 NEW DIRECTIONS IN ATOMIC PHYSICS. VOLUME 1. THEORY. Condon, Edward U.; Sinanoglu, Oktay (eds.). Yale Series in the Sciences. New Haven; Yale University Press (1972). 261p. $12.50.

Nine papers by different authors are included. The titles are as follows: Applications of Group Theory to Problems of Atomic Physics; Compact Groups in Atomic Physics; Second Quantization and Relativistic Effects in Atomic Physics; Relativistic Self-Consistent Fields; Electron Correlation in N-Electron Atoms — A New Atomic Structure Theory; Combined Configuration and Magnetic Interaction for Bound Levels of Free Atoms; Electron–Atom Scattering and Resonances; Computers and Computational Techniques in Atomic Physics; Computational Methods in the Differential Equations of Atomic Physics. (A.G.W.)

16172 MANY-BODY THEORIES OF THE ELECTRONIC STRUCTURE OF ATOMS AND MOLECULES. Freed, Karl F. (Univ. of Chicago). Annu. Rev. Phys. Chem.; 22: 313-46(1971).

The application of many-body techniques to the description of the electronic structure of atoms and molecules and the relationship of these methods to the more familiar ones of quantum chemistry are reviewed under the following headings: historical notes on many-body perturbation theory (MBPT), MBPT and correlation energies of atoms and molecules, results of MBPT calculations of correlation energies, pair–pair interaction energies, calculations of properties using MBPT, other forms of MBPT, Green's functions, many-body theory and pi-electron theory, and geometric approximations. 267 references. (A.G.W.)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

16173 PROPAGATION OF CYLINDRICAL BLAST WAVES IN MAGNETOGASDYNAMICS. Ray, G. Deb (St. Xavier's Coll., Calcutta). Z. Angew. Math. Phys.; 22: No. 5, 915-20(25 Sep 1971).

The problem of an explosion in a gas of constant density and pressure was considered previously, in the absence of any current, and the existence of an initial uniform magnetic field in the axial direction was assumed. The equations of motion in terms of two independent variables in suitable forms to effect numerical computations are given. Here, such solutions are sought, which maintain their similarity forms, except at the shock surface, heading the disturbed region. The total energy of the disturbance is nonconstant but can be made to increase at a slow rate. The solutions derived in closed forms are available for sufficiently long time and reduce to the ordinary nonmagnetic case as a particular one. Effects of viscosity and heat conduction were not taken into account. (M.H.R.)

16174 HYDROMAGNETIC INSTABILITY OF A TWO-DIMENSIONAL JET AT SMALL MAGNETIC REYNOLDS NUMBERS. Gotoh, Kanefusa; Nakata, Isamu (Kyoto Univ. Osaka Univ.). J. Phys. Soc. Jap.; 32: No. 2, 552-8(Feb 1972).

The effect of a uniform parallel magnetic field on the instability of a Bickley jet is investigated at small magnetic Reynolds numbers. The equation of disturbance is solved numerically, and it is shown that the flow is stabilized with the magnetic field. The change of the lowest critical Reynolds number R_c is shown graphically. When the magnetic field is measured by the parameter S ($= \sqrt{MR}$), where M is the Hartmann number and R is the Reynolds number, R_c is caused by the two-dimensional disturbance, provided $0 \leqq S < 5.5$. For $S > 5.5$, R_c is expressed as $R_c = 3.3\,S$, and the responsible disturbance is the three-dimensional one that propagates at angle $\cos^{-1}(5.5/S)$ to the direction of the basic flow. (auth)

16175 ELEKTROGAZODINAMIKA. (Electrogasdynamics). Rubashov, I. B.; Bortnikov, Yu. S. Moscow; Atomizdat (1971). 168p.

Problems involved in treating the motion of unipolar or polarized media in a strong electrical field are examined. General electrogasdynamic systems and flows are discussed, including basic laws and equations. Technical applications of electrogasdynamics are reviewed, and experiments with electrogasdynamic machines are described. 104 references. (tr-auth)

16176 MHD DUCT FLOWS AT MODERATE HARTMANN NUMBER. Fussey, D. E. (Central Electricity Generating Board, Southampton, Eng.). J. Phys., D (London); 4: No. 12, 1929-39(Dec 1971).

A numerical study of steady-state, fully developed, MHD duct flows is presented for the case of an applied transverse magnetic field and a two-dimensional variation of the flow parameters in the plane perpendicular to the flow direction, with no variations in fluid properties. Solutions are found for rectangular ducts with no obstacles and rectangular ducts containing thin flat plates, long in the flow direction; flow excitation by pressure gradients and moving boundaries is considered. Transverse wakes similar to those found by Hasimoto (1960) are studied in several novel circumstances. (auth)

16177 FLOW PAST A THIN BODY IN A FLUID WITH HIGH BUT FINITE CONDUCTIVITY IN A TRANSVERSE MAGNETIC FIELD. Sher'yazdanov, G. B. Magn. Gidrodin.; No. 4, 71-5 (Oct-Dec 1970). (In Russian).

The problem of a flow around a thin body of arbitrary geometry by an incompressible conducting fluid in a magnetic field is examined. In contrast to K. Stewartson and other workers, a solution was sought in the form of an asymptotic expansion by a power of the small parameter $\gamma = \mathrm{Re}_m^{-1}$, where a zero-order approximation corresponds to the case of an ideally conducting fluid. A solution was obtained for a velocity field, a magnetic field, and pressure distribution in all regions of flow with a precision of the order of $0(\gamma^2)$. (tr-auth)

16178 GENERALIZED SOLUTIONS OF STEADY CROSSED-FIELD MAGNETOHYDRODYNAMIC CHANNEL FLOWS. Cashman, J. D. (Univ. of New South Wales, Duntroon, Australia). Aust. J. Phys.; 24: No. 6, 847-57(Dec 1971).

Solutions for the flow in an MHD interaction are presented and compared when the fluid is a perfect gas, a singly ionizing monatomic gas, and a gas for which no thermodynamic model is specified. The separate effects of a changing duct area, body force, and addition of heat are presented and interpreted. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 16242.

16179 HIGH ENERGY PHYSICS AND BIG SCIENCE. Thirring, Walter (CERN, Geneva). Acta Phys. Austr.; Suppl. 8, 12-20(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

The relation of elementary particle physics to science as a whole is discussed. The economic problems are considered as well. (J.F.P.)

Electromagnetic

Refer also to abstract 16247.

16180 (DNPL/R-15, pp 57-92) PION ELECTROPRODUCTION AT THE FIRST RESONANCE. Gayler, J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

The kinematics and cross section formulas are first described, followed by a description of experimental work. Topics discussed include the following: angular coefficients; multipole fits; transition form factors; and resonance shapes. (34 references) (UK)

16181 (DNPL/R-15, pp 93-114) ELECTROPRODUCTION OF π^0 MESONS IN THE SECOND RESONANCE REGION. Foster, F. (Lancaster Univ. (England)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

Before discussing the electroproduction of π^0 mesons in the second resonance region the features of π^0 photoproduction in the same mass range are reviewed. Aims of experimental work on π^0 electroproduction are then discussed, and the experimental arrangements are described, together with the method of data analysis and calculation of differential cross sections. An attempt is made to discover the dominant trends in the data, as a guide to theory. (6 references) (UK)

16182 (DNPL/R-15, pp 115-34) COINCIDENCE MEASUREMENTS IN THE DEEP INELASTIC REGION. Brasse, F. W. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

The first stage of an experiment is reported in which the momentum distribution and total cross sections for deep inelastic $e + p \rightarrow e + p(\pi^+) + MM$ scattering at 6.5 GeV are studied. Magnetic spectrometers were used in this work. (J.F.P.)

16183 (DNPL/R-15, pp 167-213) ELECTROPRODUCTION OF π-MESONS ON PROTONS ABOVE THE SECOND RESONANCE. Heinloth, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

It is stated that a detailed study of the electro-excitation of defined hadronic states may help to understand some of the features of elastic electron-proton scattering. Applying simple models to these processes ideas about the coupling of photons to hadrons can be tested and the electromagnetic form factors of mesons and nucleon resonances can be extracted. Some general remarks are presented on the analysis of cross sections for electroproduction processes and related kinematical problems, followed by a discussion of experimental work on the electroproduction of π-mesons. Comparisons of the data are made with the vector dominance model and the electric Born term model. Possible further work on the electroproduction of π-mesons is indicated. (25 references) (UK)

16184 (DNPL/R-15, pp 215-30) RHO PRODUCTION IN DEEP INELASTIC ELECTRON SCATTERING. White, D. Hywel (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

An experiment performed at the Cornell electron synchrotron on the electroproduction of vector mesons in the deep inelastic region is described. This experiment was designed to measure the hadron final states $p + X^0$ in which X^0 is a neutral meson or collection of mesons emitted near the momentum transfer direction $\tilde{q}$; the inelastically scattered electron and the final proton from the reaction $e^- + p \rightarrow e^- + p + X^0$ are observed in coincidence and the missing mass of the X^0 is inferred by momentum and energy conservation. The motivation of an experiment of this kind is to try to establish the main channels present in the final state. Experimental details are given and results are discussed. The production of vector mesons was smaller than in photoproduction by about a factor of two. The main problem that remains is what final states dominate the deep inelastic cross section. It is speculated that the bulk of the cross section is concerned with final protons that move slowly in the c.m. system, in association with a meson system of high multiplicity and large invariant mass; this is consistent with experimental results. (14 references) (UK)

16185 (DNPL/R-15, pp 231-48) COINCIDENCE ELECTROPRODUCTION AT THE EDGE OF THE DEEP CONTINUUM. Ibbotson, M. (Manchester Univ. (England)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

An experiment is discussed that was performed at the NINA synchrotron of the Daresbury Nuclear Physics Laboratory to make a preliminary survey of hadronic channels contributing to the single arm deep continuum total cross section. Motivation was by measurements made elsewhere, which showed that the total cross section for electroproduction falls much more slowly with momentum transfer than elastic electron scattering. An account is given of the kinematics involved and details are given of the experimental method employed. Reactions considered include $e^- + p \rightarrow e^- + p + X^0$, $e + p \rightarrow e + \pi^- + X^{++}$, and $e + p \rightarrow e + \pi^+ + X^0$. (13 references) (UK)

16186 (KFK-1473) QUASIELASTIC ELECTRON-DEUTERON SCATTERING AT FOUR MOMENTUM TRANSFERS IN THE RANGE $0.25\ (GeV/c)^2 < q^2 < 0.85\ (GeV/c)^2$. Galster, S.; Hartwig, G.; Klein, H.; Moritz, J.; Schmidt, K. H.; Schmidt-Parzefall, W.; Wegener, D.; Bleckwenn, J. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug 1971. 21p. Dep. NTIS (U. S. Sales Only).

In an e-d scattering experiment the process $e + d \rightarrow e + p + n$ was studied. The scattered electrons and the recoil protons were detected with a coincidence apparatus. Within the experimental error of 6% the measured cross sections $d^2\sigma/d\Omega\ dE_3$ are in good agreement with the predictions of the Durand theory. The measured angular distributions of the recoil protons agree with theoretical predictions of McGee. There is no evidence for final state interactions or meson currents. The square of the neutron form factor G_{EN}^2 was evaluated. (auth)

16187 SYMPOSIUM ON MESON-, PHOTO-, AND ELECTROPRODUCTION AT LOW AND INTERMEDIATE ENERGIES, BONN, SEPTEMBER 21-26, 1970. Hoehler, G. (ed.). Springer Tracts in Modern Physics. Ergebnisse der Exakten Naturwissenschaften. Volume 59. New York; Springer-Verlag New York, Inc. (1971). 224p. (CONF-700948).

Separate abstracts were prepared for each of the nine papers. (J.F.P.)

For abstracts of individual papers see: 16188-16192 and 16255-16258.

16188 PION PHOTOPRODUCTION ON NUCLEONS IN THE FIRST RESONANCE REGION (EXPERIMENTAL SITUATION). von Holtey, G. (Univ., Bonn). Springer Tracts Mod. Phys.; 59: 3-26(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

The experimental situation for photoproduction of single pions on nucleons in the first resonance region using unpolarized photons is reviewed. The reactions $\gamma + p \rightarrow \pi^0 + p$, $\gamma + p \rightarrow \pi^+ + n$ and $\gamma + n \rightarrow \pi^- + p$ are considered. (J.F.P.)

16189 MULTIPLE PION PHOTOPRODUCTION IN THE s CHANNEL RESONANCE REGION. Lueke, Dieter; Soeding, Paul (Univ., Hamburg. DESY, Hamburg). Springer Tracts Mod. Phys.; 59: 39-76(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

The review covers cross sections for multiple pion production,

measurements and general results on the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, the reactions $\gamma + p \rightarrow \pi^- + \Delta^{++}(1236)$ and $\gamma + N \rightarrow \pi + \Delta(1236)$, and vector meson photoproduction. (J.F.P.)

16190 MESON PHOTOPRODUCTION ON NUCLEI. Foa, L. (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Springer Tracts Mod. Phys.; 59: 114-34(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

A review is given of experiments for the determination of the total cross sections for vector mesons on nucleons by an analysis of the photoproduction data in terms of an expression for the coherent amplitude for vector meson photoproduction on a nucleus. The ρ^0 and ω photoproduction and the Primakoff effect are discussed. (J.F.P.)

16191 PION ELECTROPRODUCTION IN THE LOW-ENERGY REGION. von Gehlen, G. (Univ., Bonn). Springer Tracts Mod. Phys.; 59: 164-87(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

The review of low-energy pion electroproduction covers aspects of electroproduction experiments and theoretical models for low-energy virtual photoproduction amplitudes. (J.F.P.)

16192 EXPERIMENTAL DATA ON PHOTOPRODUCTION OF PSEUDOSCALAR MESONS AT INTERMEDIATE ENERGIES. Fischer, H. (Univ., Bonn). Springer Tracts Mod. Phys.; 59: 188-222(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

A survey is given of existing experimental data in the energy range 0.5 to 2.5 GeV. Analysis of meson photoproduction data in the intermediate energy region, single pion photoproduction, eta and positive kaon photoproduction are discussed. The various approaches which have been made to analyze the experimental results in the resonance region are briefly described. (J.F.P.)

16193 SEARCH FOR MAGNETIC MONOPOLES IN LUNAR MATERIAL. Eberhard, Philippe H. (Univ. of California, Berkeley); Ross, Ronald R.; Alvarez, Luis W.; Watt, Robert D. Phys. Rev., D; 4: No. 11, 3260-72(1 Dec 1971).

A search for magnetic monopoles in lunar material was performed by the electromagnetic measurement of the magnetic charge of samples. All measurements were found consistent with zero charge for all samples and inconsistent with any other value allowed by the Dirac theory. Upper limits are determined for the monopole flux in cosmic radiation and for the pair-production cross section in proton-nucleon collisions. (auth)

16194 DETERMINATION OF THE ρ-MESON–NUCLEON CROSS SECTION FROM ELASTIC ρ PHOTOPRODUCTION ON DEUTERIUM. Anderson, R. L. (Stanford Linear Accelerator Center, Calif.); Gustavson, D.; Johnson, J.; (and others). Phys. Rev., D; 4: No. 11, 3245-50(1 Dec 1971).

The cross section for $\gamma + d \rightarrow \rho^0 + d$ was measured at 6, 12, and 18 GeV for t between -0.15 $(GeV/c)^2$ and -1.4 $(GeV/c)^2$. From these measurements the total and differential ρ^0-nucleon cross sections were determined together with $\gamma_\rho^2/4\pi$. (auth)

16195 MUON PAIR PRODUCTION BY ELECTRON–POSITRON COLLISIONS IN THE GeV REGION. Borgia, B. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Ceradini, F.; Conversi, M.; (and others). Lett. Nuovo Cim.; 3: No. 3, 115-20(15 Jan 1972).

The cross sections for the interactions $e^+ + e^- \rightarrow \mu^+(e^+) + \mu^-(e^-)$ at 2E = 1.5 to 2.1 GeV were measured at Adone. Tests of electron–muon equivalence, validity of quantum electrodynamics, and a specific test of crossing symmetry are given from this experiment. (J.F.P.)

16196 COINCIDENCE MEASUREMENT OF $\gamma p\Delta^+(1236)$ VERTEX FORM FACTORS. Kajiura, Nobutaka (Hiroshima Univ.). J. Sci. Hiroshima Univ. Ser. A-II; 34: No. 2, 165-93 (Sep 1970).

The excitation curve of the first nucleon resonance $\Delta(1236$ MeV), the contribution of the longitudinal photon, and $\gamma p\Delta$-vertex form factors for the reaction $e + p \rightarrow e + p + \pi^0$ were measured at the two values of squared four-momentum transfer, $q^2 = 3fm^{-2}$ and $q^2 = 8fm^{-2}$ by using the extracted beam of the 1.3-GeV electron synchrotron at the Institute for Nuclear Study, University of Tokyo. The proton decayed from the $\Delta^+(1236)$ into the forward direction with respect to virtual photon was detected in coincidence with the scattered electron. The Δ excitation curve was measured at six different invariant masses around 1220 MeV by keeping the four-momentum transfer and the virtual photon polarization to be constant. The results are analyzed in terms of helicity form factors. It was found that there is no contribution of the longitudinal photon for the $\Delta^+(1236)$ excitation, and q^2-dependence of the γp^Δ-vertex form factor is similar to the nucleon form factor up to $8fm^{-2}$. (auth) (Japan)

16197 COINCIDENCE MEASUREMENT OF NEUTRAL PION ELECTROPRODUCTION THROUGH N*(1236). Baba, Kota (Hiroshima Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.; 33: No. 3, 257-79(Mar 1971).

Differential cross sections for the reaction $e + p \rightarrow e + N^*(1236) \rightarrow e + p + \pi^0$ were measured at the forward angle of the decay proton with respect to the virtual photon direction. Extracted electrons from the INS 1.3-GeV electron synchrotron were scattered with a liquid hydrogen target and detected by a spectrometer which consists of a sector-type magnet and a counter telescope including a lead glass Cherenkov counter. The decay proton passing through a bending magnet was detected by a time-of-flight system in coincidence with the scattered electrons. The excitation curves were observed over the N*(1236) resonance region at the four momentum transfer squared q^2 of $3F^{-2}$ and for the virtual photon's polarization parameter ϵ of 0.7 and 0.5. The shape of the excitation curves well coincided with the Dalitz and Yennie's curves. Using the Rosenbluth plot for the forward cross section, the contribution of the longitudinal component of the virtual photons seems to be negligibly small as compared to that of the transverse component. (auth) (Japan)

16198 PHOTOPRODUCTION OF π^0 MESONS FROM NEUTRONS IN THE ENERGY REGION FROM 500 TO 900 MeV. Hemmi, Yasuo (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.; 33: No. 3, 339-62 (Mar 1971).

The experimental results on the ratio, $R_{90} = [d\sigma/d\Omega(\gamma n \rightarrow \pi^0 n)]/[d\sigma/d\Omega(\gamma P \rightarrow \pi^0 P)]$, at the c.m. pion angles of 60, 90, 105, 120 and 140° in the energy region of the incident photon between 500 and 900 MeV are reported. The measurement was performed by using a liquid deuterium target. The π^0 mesons and the recoiled nucleons were detected by a pair of Cherenkov counters combined with the lead spark chambers and plastic scintillation counters consisting of 16 modules, respectively. The experimental results are compared with the results of the recent phenomenological analyses. (auth) (Japan)

Weak

Refer also to abstract 15341.

16199 (LBL–350) MEASUREMENT OF THE $K_L^0 \rightarrow \pi e \nu$ ABSOLUTE DECAY RATE. Chan, Jonathan Hiong-Sing (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1971. Contract W-7405-eng-48. 70p. Dep. NTIS.

Thesis.

An analysis of 620 K_L^0 decays via the mode $K_L^0 \rightarrow \pi e \nu$ yields a rate equal to $(7.81 \pm 0.56) \times 10^6$ sec^{-1}. The data were collected from a low-energy K_L^0 experiment performed in the LRL 25-inch hydrogen bubble chamber. The K_L^0 flux was deduced from events of the reaction $K_L^0 p \rightarrow \Lambda\pi^+$ which was observed in the same experiment, using the cross section of the process $K^- p \rightarrow \Lambda\pi^0$ measured in a companion experiment, and assuming charge independence. (auth)

16200 MEASUREMENT OF K_L^0(e3) CHARGE ASYMMETRY. Ashford, V. A.; Brown, B. C.; Masek, G. E.; (and others) (Univ. of California, San Diego, La Jolla). Contract AT(11-1)-GEN-10. Phys. Lett.; 38B: No. 1,47-50(10 Jan 1972).

The charge ratio $K_L^0 \rightarrow e^+\pi^-\nu / K_L^0 \rightarrow e^-\pi^+\nu$ was investigated, which may depart from unity due to CP violation. The detector was a charge symmetric spectrometer. A sample of 640,000 clean events with reconstructed vertex in vacuum was obtained and $\delta = 0.0036 \pm 0.0018$ was found after mass absorption corrections. (auth)

16201 LIMIT ON CPT INVARIANCE USING K^0 MESONS AND A MEASUREMENT OF THE K_s BRANCHING RATIOS. Morse, R. (Univ. of Colorado, Boulder); Nauenberg, U.; Bierman, E.; Sager, D.; Colleraine, A. P. Phys. Rev. Lett.; 28: No. 6, 388-91(7 Feb 1972).

The production of 12,849 K^{0}'s by K^+d charge exchange at 615 MeV/c and the subsequent decays occurring within 6 K_s mean lifetimes were observed in the Brookhaven National Laboratory 30-in. bubble chamber. The results are $Re\delta = -0.0017 \pm 0.0072$ (where δ is the CPT-nonconserving parameter), rate $(K_s \rightarrow \pi^+\pi^-)$/rate$(K_s \rightarrow \pi^0\pi^0) = 2.22 \pm 0.08$, and rate $(K_s \rightarrow \gamma\gamma)$/rate $(K_s \rightarrow$ all) $\leq 2 \times 10^{-3}$ (90% confidence level). (auth)

Strong (Baryon-induced)

Refer also to abstract 16376.

16202 STUDY OF $p\pi^+\pi^-$ ISOBARS PRODUCED IN THE $pp\pi^+\pi^-$ FINAL STATE BY pp INTERACTIONS AT 16 GeV/c. Rushbrooke, J. G. (Cavendish Lab., Cambridge, Eng.); Williams, J. R.; Barford, N. C.; Losty, M. J.; Pongpoonsuksri, K. Phys. Rev., D; 4: No. 11, 3273-81(1 Dec 1971).

Enhancements were observed at around 1450 and 1700 MeV in the $p\pi^+\pi^-$ mass spectrum for the $pp\pi^+\pi^-$ final state produced in pp interactions at 16 GeV/c. The results show that the 1700-MeV effect does not have a dominant $\Delta^{++}\pi^-$ decay mode. An attempt was made to determine the spin assignments. $J = 1/2$ is favored for the 1450-MeV enhancement, assuming that this decays via the uncorrelated $p\pi^+\pi^-$ mode. For the 1700-MeV enhancement, contributions are required from one or more of the spin-parity series $3/2^-$, $5/2^+$, $7/2^-$ in accord with the proposed Gribov–Morrison parity rule. (auth)

16203 ANGULAR DISTRIBUTIONS OF PARTICLE SHOWERS IN PROTON–NUCLEON INTERACTIONS AT 76 GeV ENERGY. Takibaev, Zh. S.; Boos, E. G.; Rus'kina, G. Ya. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 67-70(Mar-Apr 1971). (In Russian).

Experimental data on nucleon–nucleon interactions were obtained with nuclear emulsions irradiated in the Serpukhov accelerator at an energy of 76 GeV. Multiplicity distributions were obtained and angular characteristics of the showers were measured at three intervals of multiplicity. (4 figures). (tr-auth)

16204 DIFFERENTIAL CROSS SECTION FOR NEUTRAL PION PRODUCTION IN 600 MeV PROTON–HYDROGEN COLLISIONS. Gugelot, P. C.; Kullander, S.; Landau, G.; Lemeilleur, F.; Yonnet, J. (CERN, Geneva). Nucl. Phys.; B37: No. 1, 93-113(1971).

The five-dimensional differential cross section $\partial^5\sigma/p_\pi^2\partial p_\pi\partial\Omega_\pi\partial\Omega_1$ for the reaction $pp \rightarrow pp\pi^0$ was measured with 600 MeV incident protons on hydrogen for coplanar geometry. This cross section depends on the pion momentum, the pion emission angle and the proton scattering angle. The variation of the cross section as a function of the pion angle shows a $\cos^4$ dependence. An attempt was made to calculate the cross section using a phenomenological model. The angular dependence is fairly well reproduced. However the absolute value of the cross section is too small by at least a factor of three. (auth)

16205 SINGLE γ-RAY SPECTRA FROM PROTON–PROTON COLLISIONS AT CENTRE-OF-MASS ENERGIES FROM 30 TO 50 GeV. Neuhofer, G. N.; Niebergall, F.; Penzias, J.; (and others). Phys. Lett., 38B: No. 1, 51-4(10 Jan 1972).

The energy spectra of single γ-rays produced in proton–proton collisions at the CERN Intersecting Storage Rings were measured at three primary energies and four production angles: $E_{CM} = 30.2$ GeV, 44.7 GeV and 52.7 GeV, $\theta_{CM} = 10.2°$, 16.4°, 23.5°, and 90°. The results are shown to be compatible with the conjecture of limiting distributions. A simple interpolation formula is presented. (auth)

16206 PROPERTIES OF THE INCLUSIVE PION SPECTRUM FROM pp COLLISIONS: 28.5 GeV/c TO ABOUT 10^3 GeV/c. Panvini, R. S. (Brookhaven National Lab., Upton, N. Y. Vanderbilt Univ., Nashville).; Kinsey, R. R.; Morris, T. W.; (and others). Phys. Lett.; 38B: No. 1, 55-9(10 Jan 1972).

The spectra of pions are studied in the inclusive reactions $p + p \rightarrow \pi^\pm$ + anything in bubble chamber data at 28.5 GeV/c. Comparisons are made with ISR π^+ spectra to examine energy dependence. (auth)

16207 STUDY OF NUCLEAR ACTIVE PARTICLES IN EXTENSIVE AIR SHOWER. Yoshi, Hisashi (Ehime Univ., Japan). J. Phys. Soc. Jap.; 32: No. 2, 295-305(Feb 1972).

The high-energy nuclear active particles (NAP) of more than 200 GeV, associated with EAS, were studied by means of the large-area scintillation detectors under water tank, at the mountain altitude of 2770 m a.s.l. The following results were obtained: the energy spectrum of NAP has a knee at about 500 GeV where the spectrum index changes from −1.0 to −1.8, the lateral distribution of NAP can be expressed as A exp $(-r/r_0)$ with r_0 of 1 ~ 2m, the number of NAP is much smaller than the results of the Monte Carlo simulations assuming the ordinary interaction model, and the mean transverse momentum of NAP is about 2 GeV/c which is much higher than generally accepted value in the nuclear interactions. (auth)

16208 COSMIC-RAY EXPERIMENTS AND THE SCALING HYPOTHESIS. Bali, N. F.; Brown, Lowell S.; Peccei, R. D. (Univ. of Washington, Seattle). Phys. Rev., D; 4: No. 9, 2760-7(1 Nov 1971).

Angular distributions obtained in cosmic-ray experiments are examined with a view to test the scaling hypothesis. Using appropriately scaled parametrizations of accelerator production data, the experimental results obtained at the Echo Lake facility in the range of 150 to 300 GeV are analyzed. It is found that the scaling hypothesis accounts for the main features of the data. However, both uncertainties in the scaled parametrizations used and the many experimental biases that need to be corrected preclude a critical test. It is concluded that direct measurements at the new accelerators are necessary for a definitive test of scaling. (auth)

16209 OBSERVATION OF CASCADE HYPERON INTERACTIONS. Muller, R. A. (Univ. of California, Berkeley). Phys. Lett.; 38B: No. 2, 123-4(24 Jan 1972).

The observation of 17 Ξ^0 + p interactions in the Berkeley 72″ hydrogen bubble chamber is reported. Cross sections are calculated for both elastic and inelastic channels. (auth)

Strong (Meson-induced)

Refer also to abstracts 15325, 16309, 16310, 16314, and 16349.

16210 SEARCH FOR $\Lambda(1327)$ IN K^-p INTERACTIONS AT 740 MeV/c. Binkley, M. E.; Carpenter, D. W.; Elliott, J. R.; (and others) (Duke Univ., Durham, N. C.). Phys. Rev., D; 4: No. 11, 3250-3(1 Dec 1971).

A search is made for $K^-p \rightarrow \Lambda(1327)\pi^0$, $\Lambda(1327) \rightarrow \Lambda\gamma$ with 740-MeV/c K^- mesons. No evidence is found for $\Lambda(1327)$ production and it is concluded with 90% confidence that any such production occurs at less than 7% of the rate of $K^-p \rightarrow \Sigma^0\pi^0$. (auth)

16211 MEASUREMENT OF THE $T = 3/2$ $K\pi$ ELASTIC SCATTERING CROSS SECTION USING THE DUERR–PILKUHN FORM FACTOR. Kirschbaum, A. R. (Univ. of California, Berkeley); Colton, E.; Dauber, P. M.; Friedman, J. H.; Schlein, P. E. Phys. Rev., D; 4: No. 11, 3254-60(1 Dec 1971).

A reanalysis of original pole-extrapolation measurements of the $K^-\pi^-$ elastic scattering cross section for two intervals in $K\pi$ invariant mass from threshold to 0.84 GeV is presented. The measurements were obtained from the reaction $K^-p \rightarrow K^-\pi^-\Delta^{++}$ at 2.05 and 2.63 GeV/c. It is now shown how the effect of the background from the competing one-pion-exchange process $K^-p \rightarrow (K^-\pi^+)(\pi^-p)$ can be approximately accounted for. It is found that the extrapolated cross sections are relatively insensitive to the presence of this background. In addition some recent measurements of the $T = 3/2$ $K\pi$ cross section are summarized. (auth)

16212 ABSORPTION CROSS SECTIONS OF $K^\pm$ AND $\bar{p}$ ON CARBON AND COPPER IN THE REGION 1.0 TO 3.3 GeV/c. Abrams, R. J.; Cool, R. L.; Giacomelli, G.; (and others) (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 4: No. 11, 3235-44(1 Dec 1971).

Measurements of $K^\pm$-meson and $\bar{p}$ absorption cross sections on carbon and copper in the region 1.0 to 3.3 GeV/c are presented. (auth)

16213 SOME RECENT EXPERIMENTAL RESULTS FOR A_1, A_3, Q, AND L MESONS. Kruse, U. E. (Univ. of Illinois, Urbana). pp 27-47 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A brief summary is given of the methods of analysis; then the production and properties of the A_1, A_3, Q and L mesons including the question of s- versus t-channel helicity conservation are discussed. (J.F.P.)

16214 RECENT RESULTS FROM BUBBLE CHAMBER EXPERIMENTS ON A_2. Lai, Kwan-wu (Brookhaven National Lab., Upton, N. Y.). pp 257-93 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Recent results on the A_2 meson from bubble chamber experiments are discussed. The mass and fine structure, production cross sections, spin-density matrix, and branching ratio are considered. (J.F.P.)

16215 $A_2^\pm$ MASS SPECTRUM IN π^+p INTERACTIONS AT 3.7 GeV/c. Barnham, K. W. J.; Abrams, G. S.; Butler, W. R.; (and others) (Univ. of California, Berkeley). pp 295-306 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Evidence in favor of the splitting of the A_2^+ produced in $\pi^+ + p$ interactions at 3.7 GeV in a hydrogen bubble chamber is reported. The splitting occurs in the t′ range 0.1 to 2.0 GeV^2. The dipole fit is favored over a single Breit–Wigner with confidence levels of 53 and 11% respectively. Branching ratios were also found for the A_2^+ decays into $\rho\pi$, $\eta\pi$, $K\bar{K}$, and $\eta'\pi$. (J.F.P.)

16216 f^0 MASS SPECTRUM IN 7 GeV/c π^+p INTERACTIONS. Flatte, S. M. (Univ. of California, Berkeley). pp 322-5 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

It is reported that no narrow structure is seen in the f^0 region in $\pi^+ + p \rightarrow 2\pi^+ + \pi^- + p$ interactions at 7 GeV/c. The resolution is 7.8 MeV half width at half maximum in the f^0 peak region. (J.F.P.)

16217 DOUBLE VEE MAGNETIC SPECTROMETER: EXPERIMENTAL SETUP AND CURRENT RESULTS. Ozaki, S. (Brookhaven National Lab., Upton, N. Y.). pp 326-57 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Some experiments which were previously performed to determine the performance of the double vee spectrometer are described. These experiments are $\pi^- + p \rightarrow K^0 + \Lambda(\Sigma^0)$ and $\pi^- + p \rightarrow K^0 + Y^{*0}$ at 8.0 GeV/c and $\pi^- + p \rightarrow A_2^- + p$, $A_2^- \rightarrow K^- + K^0$ at 20.3 GeV/c. The mass distributions are found for the first interactions, and A_2^- effective mass is found for the last interaction. (J.F.P.)

16218 MEASUREMENTS OF THE A_2^- AND A_2^+ SPECTRA. Bowen, D. (Northeastern Univ., Boston); Earles, D.; Faissler, W.; (and others). pp 358-86 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A_2^- mass spectra from the interaction $\pi^- + p \rightarrow A_2^- + p$ at 5 and 7 GeV/c and A_2^+ mass spectra from the interactions $\pi^+ + p \rightarrow A_2^+ + p$ at 5 GeV/c were found. These spectra show no fine structure, and their mass distributions are well described by the Breit–Wigner formula. (J.F.P.)

16219 REVIEW OF SOME EXPERIMENTAL RESULTS ON HADRON–DEUTERIUM SCATTERING. Musgrave, B. (Argonne National Lab., Ill.). pp 467-553 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

The problems in obtaining cross sections, differential cross sections and decay angular distributions of resonances for $\pi + d$ and $K + d$ interactions above 2 GeV/c are reviewed. (J.F.P.)

16220 STUDY OF THE REACTION $\pi^-p \rightarrow \rho^0n$ AT 15 GeV/c. Bulos, F. (Stanford Univ., Calif.); Carnegie, R. K.; Fischer, G. E.; (and others) pp 555-73 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

The results of a wire spark chamber experiment studying the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ at 15 GeV/c are presented. The differential cross section, $\pi-\pi$ mass distribution, and density matrix elements were determined from 10,000 $\pi\pi n$ events ($M_{\pi\pi} <$ 1.0 GeV) produced with $-t < 0.30$ (GeV/c)^2. Both the density matrix elements and the differential cross section exhibit structure in the forward direction ($-t < m_\pi^2$). (auth)

16221 COMPARISON OF $\pi^-p \rightarrow \rho^0n$ WITH SINGLE PION PHOTOPRODUCTION AT 15 GeV/c. Bulos, F. (Stanford Univ., Calif.); Carnegie, R. K.; Fischer, G. E.; (and others) pp 574-83 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A comparison of new data on $\pi^- + p \rightarrow \rho^0 + n$ at 15 GeV/c with polarized and unpolarized single pion photoproduction data is presented. Particular emphasis is placed upon the behavior of the differential cross sections and asymmetries in the forward direction, ($-t < m_\pi^2$). (auth)

16222 COMPARISON OF ABSORPTIVE ONE PION EXCHANGE MODEL WITH MEASUREMENTS OF $\pi^-p \rightarrow \pi^+\pi^-n$. Baillon, P. (Stanford Univ., Calif); Bulos, F.; Carnegie, R. K.; (and others) pp 585-93 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

The results of a wire spark chamber experiment studying the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ at 15 GeV/c are compared with the predictions of the absorptive one pion exchange model. The rich structure at small values of momentum transfer observed in the data is well described by the model. (auth)

16223 SOME NEW EXPERIMENTAL RESULTS WITH POLARIZED TARGETS. I. Dick, L. (CERN, Geneva). pp 594-611 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

The recoil proton polarization was measured in $\pi^+ + p$, $\pi^- + p$, $K^+ + p$, $K^- + p$, $\bar{p} + p$, and $p + p$ elastic scattering at 6 to 17.5 GeV/c and absolute values of the momentum transfer 0.1 to 2.7 (GeV/c)^2. (J.F.P.)

16224 SOME NEW EXPERIMENTAL RESULTS WITH POLARIZED TARGETS. II. Yokosawa, A. (Argonne National Lab., Ill.). pp 612-28 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

New results are presented for polarization measurements on $\pi^+ + p$, $\pi^- + p$, and $K^+ + p$ elastic scattering at high energies. Also preliminary $\pi^- + p$ charge exchange polarization results are given. (J.F.P.)

16225 5-GeV/c PION–NUCLEON SCATTERING AT ALL ANGLES. Chu, Shu-Yuan; Hendry, Archibald W. (Indiana Univ., Bloomington). Phys. Rev., D; 4: No. 11, 3282-9(1 Dec 1971).

All $\pi^\pm p$ elastic and charge-exchange data at 5 GeV/c are fitted on the basis of a simple geometric s-channel model. (auth)

16226 RESONANCE PRODUCTION IN THE REACTIONS $K^+p \rightarrow KN\pi$ IN THE INTERMEDIATE ENERGY RANGE. Brunet, J. M. (College de France, Paris); Narjoux, J. L.; Danysz, J. A.; (and others). Nucl. Phys.; B37: No. 1, 114-32(1971).

Cross sections and angular distributions are presented for resonances produced in the reactions $K^+p \rightarrow KN\pi$ at momenta between 2.11 and 2.72 GeV/c. Production of $K^*(892)$ and $\Delta(1236)$ dominates these reactions. Some contributions from higher resonances are also found. Structures in the s-channel are discussed. (auth)

16227 π^+p ELASTIC SCATTERING BETWEEN 0.6 AND 0.8 GeV/c. Bowler, M. G.; Cashmore, R. J.; Kaddoura, A. (Oxford Univ.). Nucl. Phys.; B37: No. 1, 133-60(1971).

The π^+p differential elastic scattering cross sections are presented at five momenta between 0.6 and 0.8 GeV/c. The data were collected in a bubble chamber exposure and consequently are susceptible to different systematic errors from counter experiments. The results are generally in good agreement with those of counter experiments in the same momentum range and with the predictions of the various elastic partial wave analyses. The majority of partial wave analyses do not however yield parameters which fit the data in detail without modification. (auth)

16228 A_2^+ PRODUCTION IN 5.45 GeV/c π^+p INTERACTIONS. Bloodworth, I. J.; Jackson, W. C.; Prentice, J. D.; Yoon, T. S. (Univ. of Toronto). Nucl. Phys.; B37: No. 1, 203-11(1971).

A_2^+ production in a π^+p experiment at 5.45 GeV/c is reported. The fitted values for the mass and width are given, and the production characteristics are illustrated by the momentum transfer distributions and average density matrix elements. A depletion of events is observed near 1.3 GeV which favors a double pole amplitude or two interfering resonances over a simple Breit–Wigner formula. (auth)

16229 COHERENT PRODUCTION OF THREE PIONS BY π^- MESONS WITH MOMENTUM 5 GeV/c ON CARBON NUCLEI. Amaglobeli, N. S. (Tbilisi State Univ., USSR); Budagov, Yu. A.; Vinogradov, V. B.; (and others). JETP Lett. (USSR) (Engl. Transl.); No. 10, 385-7(20 Nov 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 10, 558-61(20 Nov 1971).

Four-momentum and effective-mass distribution and cross sec-

tions are obtained for three-pion production from 5-GeV/c negative pions reacting with carbon in a propane bubble chamber. (J.F.P.)

16230 EXPERIMENTAL STUDY OF OMEGA NEUTRAL DECAYS. Dakin, James T. Princeton, N. J.; Princeton Univ. (1971). 139p. University Microfilms Order No. 71-25,936.

Thesis.

The neutral decay modes of the ω meson (784 MeV) were studied in an experiment at the Princeton-Pennsylvania Accelerator. A sample of 532 ω natural decays from the reaction $\pi^- p \rightarrow \omega n$ was identified from the times-of-flight and angles of the neutrons. The momentum of a single γ from each decay was measured in a wide-aperture pair spectrometer. The γ momentum was transformed to the ω c.m. system. The resulting γ (c.m.) spectrum was compared with spectra for various ω decay modes generated by a Monte Carlo program. The principal ω neutral decay, $\omega \rightarrow \pi^0\gamma$, was observed with a branching ratio $(\omega \rightarrow \pi^0\gamma)/(\omega \rightarrow \text{neutrals}) = (65 \pm 7)\%$. The upper limit for the decay $\omega \rightarrow \eta\gamma$ was $(\omega \rightarrow \eta\gamma)/(\omega \rightarrow \text{neutrals}) < 25\%$(90% confidence limit). A multi-body decay, probably $\omega \rightarrow \pi^0\pi^0\gamma$, was observed with a branching ratio $(\omega \rightarrow \pi^0\pi^0\gamma)/(\omega \rightarrow \text{neutrals}) = (35 \pm 7)\%$. (Diss. Abstr. Int., B)

16231 MEASUREMENTS OF $\pi^- p \rightarrow \pi^0 n$ REACTION CROSS-SECTION IN THE MOMENTUM RANGE UP TO 50 GeV/c. Bolotov, V. N.; Devishev, M. I.; Devisheva, M. N.; (and others) (Inst. of High Energy Physics, Serpukhov, USSR). Phys. Lett.; 38B: No. 2, 120-2(24 Jan 1972).

Cross section data are presented for pion proton charge-exchange scattering in the momentum range 20 to 50 GeV/c. The experiments were performed at 70 GeV IHEP accelerator. (auth)

16232 DECAY $\phi \rightarrow \eta\gamma$. Basile, M.; Dalpiaz, P.; Frabetti, P. L.; (and others) (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. Centre National des Recherches Scientifiques, Strasbourg). Phys. Lett.; 38B: No. 2, 117-19(24 Jan 1972).

In a study of the reaction $\pi^- p \rightarrow n\phi$ at 1.8 GeV/c incident pion momentum, (27 ± 6) events of the type $\phi \rightarrow \eta\gamma$ have been observed. The branching ratio $R_1 = \Gamma(\phi \rightarrow \eta\gamma)/\Gamma(\phi \rightarrow \text{total})$ turns out to be $R_1 = (7.3 \pm 1.8)\%$ and favors quadratic mixing in both vector and pseudoscalar nonets. (auth)

Particle Interactions and Properties (Theoretical)

General

16233 (COO-264-597) DYNAMICS UNDERLYING DUALITY AND GAUGE INVARIANCE IN THE DUAL RESONANCE MODEL. Chang, Lay Nam (Pennsylvania Univ., Philadelphia. Dept. of Physics); Mansouri, Freydoon (Chicago Univ., Ill. Enrico Fermi Inst.). Dec 1971. Contract AT(11-1)-264. 26p. (EFI-71-72). Dep. NTIS.

Making use of the similarity between the factorized spectrum of the generalized beta-function and the spectrum of a vibrating string in Minkowski space, formalism is constructed within which a geometrical interpretation is given to the gauge symmetries inherent in the theory. The key point in the construction is the identification of the harmonic oscillator amplitude with the components of actual coordinates in space-time. It turns out that these coordinates must satisfy certain constraints arising from purely geometrical considerations, and these constraint equations are then shown to be the familiar gauge conditions on the underlying states. Analogies with more familiar gauge theories are pointed out. (auth)

16234 CONCEPTS IN HADRON PHYSICS. Proceedings of the 10th International University Week for Nuclear Physics of the Graz University, Schladming, Austria, March 1–13, 1971. Urban, Paul (ed.). Acta Phys. Austr.; Suppl. 8, 1-424(1971). (CONF-710338).

Separate abstracts were prepared for each of the 13 lectures. (J.F.P.)

For abstracts of individual lectures see: 16179, 16235, 16254, 16287, 16288, 16301–16303, 16329, and 16388–16391.

16235 TEN YEARS OF SCHLADMING; REFLECTION OF THE DEVELOPMENTS IN HIGH ENERGY PHYSICS. Urban, Paul (Univ., Graz.). Acta Phys. Austr.; Suppl. 8, 1-11(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

A review is given in some detail of the problems covered in the Schladming winter schools. Among the topics considered are vector mesons, Regge pole theory, axiomatic field theory, potential theory, weak interactions, higher symmetries, quantum electrodynamics, various elementary particle physics theories, CP violation, and the Veneziano model. (J.F.P.)

16236 REPRESENTATIONS OF A FUNCTION MEASURED INSIDE ITS ANALYTIC DOMAIN. Shih, C. C. (Carnegie-Mellon Univ., Pittsburgh. Univ. of Tennessee, Knoxville). Phys. Rev., D; 4: No. 11, 3293-8(1 Dec 1971).

Problems concerning insufficient information provided for a function inside its analytic domain are examined in detail in a simplified statistical model of Cutkosky. The solution is in general closely related to a very simple integral equation. With a finite number of input data, it reduces to an algebraic equation and is readily solved in closed analytic form. Successive iterations and "optimal geometry" dealing with optimal distribution of input data are also discussed. (auth)

16237 LOCAL OBSERVABLES AND PARTICLE STATISTICS. I. Doplicher, Sergio (Univ., Marseille); Haag, Rudolf; Roberts, John E. Commun. Math. Phys.; 23: No. 3, 199-230(1971).

The family of those states which become asymptotically indistinguishable from the vacuum for observations in far away regions of space is considered. The pure states of this family may be subdivided into superselection sectors labeled by generalized charge quantum numbers. The principle of locality implies that within this family one may define a natural product composition (leading for instance from single particle states to n-particle states). Intrinsically associated with the n-fold product of states of one sector there is a unitary representation of $P^{(n)}$, the permutation group of n elements, analogous in its role to that arising in wave mechanics from the permutations of the arguments of an n-particle wave function. It is shown that each sector possesses a "statistics parameter" λ which determines the nature of the representation of $P^{(n)}$ for all n and whose possible values are 0, $\pm d^{-1}$ (d a positive integer). A sector with $\lambda \neq 0$ has a unique charge conjugate ("antiparticle" states); if $\lambda = d^{-1}$ the states of the sector obey para-Bose statistics of order d, if $\lambda = -d^{-1}$ they obey para-Fermi statistics of order d. Some conditions which restrict λ to ±1 (ordinary Bose or Fermi statistics) are given. (auth)

16238 SUM RULES FOR CORRELATION FUNCTIONS IN INCLUSIVE REACTIONS. Tye, S.-H. H. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Lett. Nuovo Cim.; 2: No. 25, 1271-6(18 Dec 1971).

An expression derived for multiparticle inclusive interactions is shown to be equivalent to the Predazzi–Veneziano relation for n- and m-particle inclusive reactions. The expression is then written in terms of correlation functions. Some applications are indicated. (L.B.S.)

16239 ORIGIN AND PHYSICAL MEANING OF WARD-LIKE IDENTITY IN DUAL-RESONANCE MODEL. Hara, Osamu (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1549-59(Nov 1971).

It is shown for the string model that the Ward-like identities in the dual-resonance model proposed by Fubini, Veneziano, and Virasoro followed directly from the requirement that the theory must be covariant under an arbitrary transformation of the Lagrange coordinate labeling each constituent part of the string. Thus at least for the string model, these identities are a necessary consequence of a general principle to be satisfied by any consistent physical theory. Our discussion is restricted to the case $\alpha(0) = 1$, i.e., intercept one. (auth)

16240 UR-CITON: AN ATTEMPT FOR UNIFIED THEORY OF HADRONS. Ishida, Shin (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1570-86(Nov 1971).

A theoretical scheme for unified treatment of the world of all hadrons is presented, which includes heuristically the successes of the quark model without the well-known difficulties regarding spin-statistics connection and binding problem. The essential idea exists in the following: Introducing the operator $\psi_A(p,\xi)$, called "ur-citon" which transforms similarly to the quark, depends on the internal Lorentz variables ξ, and is quantized through Bose-type commutation relations; we consider the "inner Fock expansion" of the general "inner state vector". Then the expansion coefficients, which satisfy the "generalized Bargmann–Wigner equations," are considered to represent hadron fields, and are "second-quantized" following the prescription of the usual quantum field theory. The level scheme of mesons and baryons is given through the system of two and three three-dimensional harmonic oscillators, respectively, contrasting with one and two oscillators in the quark model. A general scheme for getting various kinds of effective vertices among hadrons is investigated

also from the same unified view-point. A tentative application to the electromagnetic form factors of nucleons is shown to lead to a satisfactory result which reproduces the famous experimental behavior, the scaling law and the dipole-like behavior. Weak interactions among hadrons and leptons are, similarly to the usual theory, assumed to be given by a "current-current"-like interaction, where its parts relevant to hadrons are treated by our uriton scheme. (auth)

16241 CONSTRAINTS ON SPIN ROTATION PARAMETERS DUE TO ISOSPIN CONSERVATION. Doncel, M. G. (Univ. Autonoma, Barcelona); Michel, L.; Minnaert, P. Phys. Lett.; 38B: No. 1, 42-4(10 Jan 1972).

A complete study was made of the relations between the three cross sections and the three sets of spin rotation parameters P, A, R for three reactions related by internal symmetry via two channels. (auth)

16242 FINAL STATE INTERACTIONS. Slobodrian, R. J. (Univ. Laval, Quebec). Rep. Progr. Phys.; 34: No. 3, 175-277 (1971).

Final-state interactions are common ground between nuclear and particle physics. They are fruitful because they enable us to infer properties of two (or more)-body systems, or very short-lived "particles" which are otherwise impossible to reach. There are of course numerous difficulties associated with their study, both experimental and theoretical, but considerable understanding has been accomplished in recent years and a survey is presented here. The study of these interactions is also related further to interesting aspects of the two-body interaction not obtainable through elastic scattering, like off-the-energy shell transitions, aspects of quasi-free scattering, and specific three-body effects, such as three-body forces. (auth)

16243 VANISHING OF TRIPLE REGGEON VERTICES. Abarbanel, H. D. I.; Green, M. B. (Inst. for Advanced Study, Princeton, N. J.). Phys. Lett.; 38B: No. 2, 90-2(24 Jan 1972).

It is demonstrated that a nonsense wrong signature zero is responsible for the vanishing of the triple Pomeron vertex with all legs at zero mass. The key input is the vanishing of certain fixed pole residues which is enforced by unitarity. Some other consequences of this general feature are drawn. (auth)

16244 SHORT-RANGE CORRELATIONS IN TWO-PARTICLE PRODUCTIONS. Jen, C.-L.; Kang, K.; Shen, P.; Tan, C.-I. (Brown Univ., Providence). Phys. Lett.; 38B: No. 2, 81-4 (24 Jan 1972). (COO-3130TA-255).

Based on the analysis of the eight-point dual amplitude, it is shown that the two-particle distribution function exhibits a transverse momenta cutoff of the form, $\exp\{-4(p_1^{\perp 2} + p_2^{\perp 2} + 2p_1^{\perp}p_2^{\perp}\cos\beta)\}$, in the pionization region, where β depends on the relative rapidity y and the relative azimuthal angle ϕ between $p_1^{\perp}$ and $p_2^{\perp}$. Explicit correlation function is obtained to the exp (-y) order. As it is expected from a Mueller analysis, the correlation length in y is found to be $(\alpha_v - \alpha_{v'})^{-1}$ in terms of the two leading vacuum trajectories with positive intercepts. (auth)

Electromagnetic

Refer also to abstracts 16187, 16191, and 16406.

16245 (COO-264-594) MUON PAIR CREATION VIA TWO PHOTON EXCHANGE IN CHARGED PARTICLE COLLISIONS. II. HADRON COLLISIONS. Fujikawa, Kazuo (Chicago Univ., III. Enrico Fermi Inst.). Sep 1971. Contract AT(11-1)-264. 27p. (EFI-71-69). Dep. NTIS.

Muon pair creation via two photon exchange in charged hadron collisions is discussed based on a numerical calculation as well as on an analytical formula. The form factor and also the large mass of hadrons make this cross section very small for a large invariant mass of the muon pair at low energies. However, at extremely high energies and for not so massive muon pairs the present process becomes comparable with other semi-leptonic processes. This process may be measurable at NAL energies. Also the q^2-dependence of the missing mass spectrum in the ordinary deep inelastic process is briefly discussed based on a muon-parton analogy. (auth)

16246 (COO-1573-93) STUDY OF PHOTON-PHOTON INTERACTIONS VIA ELECTRON-ELECTRON AND ELECTRON-POSITRON COLLIDING BEAMS. Brown, R. W. (Case Western Reserve Univ., Cleveland, Ohio); Muzinich, I. J. (Brookhaven National Lab., Upton, N. Y.). Feb 1971. 37p. (BNL-15713). Dep. NTIS.

A formalism is presented for studying the virtual photon-photon interaction available through electron-electron and electron-positron colliding beams. The two-photon processes are analyzed via the density-matrix approach presented before by Muzinich, Wang, and Wang utilizing simple representations of the 0(2,1) group for the space-like lepton vertices. A discussion of the high-energy behavior of some particular hadron production amplitudes as determined by Regge theory is given. In particular the possibility of measuring the real photon-photon hadron production cross sections is emphasized. If only the final lepton momenta are measured and one attempts to isolate the total real photon-photon cross section into hadrons, there are electromagnetic background effects that may make this measurement difficult. A set of invariant amplitudes for forward virtual photon-photon scattering is included. (auth)

16247 (DNPL/R-15) INELASTIC ELECTRON SCATTERING. Proceedings of the Daresbury Study Weekend, 11-13 June 1971. Daresbury Study Weekend No. 3. Donnachie, A. (ed.) (Daresbury Nuclear Physics Lab. (England)). 1971. 317p. (CONF-710638).

Eleven papers were presented, abstracts for all of which were prepared. (UK)

For abstracts of individual papers see: 16180-16185 and 16248-16252.

16248 (DNPL/R-15, pp 1-56) PHENOMENOLOGICAL ANALYSES OF PHOTOPRODUCTION IN THE RESONANCE REGIONS. Rankin, W. A. (Manchester Univ. (England). Dept. of Theoretical Physics. Daresbury Nuclear Physics Lab. (England)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

The subject is discussed under the following headings: phase shift analyses of pion photoproduction (amplitudes; parametrizations and procedures of phase shift analyses; second resonance region phase shift results; third resonance region phase shift results); resonance dominated fixed-t dispersion relations and resonance dominance; phenomenology in the fourth resonance region; resonance dominated fixed-t dispersion relations in the second and third resonance regions; angular distributions); the nonrelativistic symmetric quark model (states and wave functions; mixing information from strong interactions; and electromagnetic transitions). (35 references) (UK)

16249 (DNPL/R-15, pp 135-48) MODELS FOR DEEP INELASTIC ELECTRON SCATTERING. Landshoff, P. V. (Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

Amongst matters discussed are the following: scaling of structure functions; deep inelastic electroproduction data; vector-meson dominance; pomeron exchange; dimensional arguments; scale transformations; light-cone structure of operators; role of resonances; Feynman's parton hypothesis; contribution of an infinite number of resonances; parton-quark hypothesis; etc. (28 references) (UK)

16250 (DNPL/R-15, pp 149-65) RADIATIVE CORRECTIONS TO COINCIDENCE ELECTROPRODUCTION MEASUREMENTS. Dickinson, B. (Manchester Univ. (England)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

Radiative corrections to the reactions $e + p \rightarrow e + p + \pi^0$ in the region of the $\Delta(1236)$ resonance are considered. It is assumed that the scattered electron and recoil proton are detected in coincidence and the direction and momentum of each particle is determined. (J.F.P.)

16251 (DNPL/R-15, pp 249-68) PION ELECTROPRODUCTION AND THE VECTOR DOMINANCE MODEL. Kellett, B. H. (Manchester Univ. (England). Dept. of Theoretical Physics).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

It is stated that recent coincidence measurements of single pion electroproduction above the resonance region provide an interesting test for the hypothesis of vector meson dominance (VMD). The results of a new calculation are presented based on a slightly different approach to VMD than that adopted previously. It is concluded that VMD predictions from pion photoproduction give an excellent representation of π^- electroproduction. The most important feature of the results is that, within the framework of VMD, pion electroproduction, pion photoproduction and vector meson production can be described in terms of the same basic dynamical model. The underlying dynamics for pion electroproduction and vector meson production are seen to be directly related to the gauge invariant structure of pion photoproduction. (16 references) (UK)

16252 (DNPL/R-15, pp 269-317) THEORETICAL ANALYSIS OF PION ELECTROPRODUCTION. Lyth, D. H. (Lancaster Univ. (England)).

From Proceedings of the Daresbury study weekend; Daresbury, England (11 Jun 1971).

The fixed-t dispersion relation approach to the study of single pion electroproduction, including photoproduction as a special case, is examined. This approach, with higher resonances included, is being used to study data on electroproduction. Headings are as follows: cross section formulas; one photon exchange ("field theory" approach; helicity amplitude approach; current conservation-gauge invariance-and the photoproduction limit); fixed-t dispersion relations; resonance saturation of the absorptive part; and comparisons with experimental data. Formulas that relate the invariant amplitudes to the s- and t- channel helicity amplitudes are given. (30 references) (UK)

16253 (FRNC-R-5) ELECTROMAGNETIC DISINTEGRATION OF BOSONS. Paty, M. (Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Recherches Nucleaires). 1970. 82p. (In French). (CONF-700975-1). Dep. NTIS (U. S. Sales Only).

From sixth International School of Elementary Particle Physics; Herceg Novi, Yugoslavia (13 Sep 1970).

The electromagnetic disintegration of the bosons of the 0^- and 1^- multiplets were studied. The decay modes considered are: the two-photon emission (pseudoscalar case) π^0, η^0, $\chi^0 \rightarrow 2\gamma$; the emission of a single photon and a hadron system such as $\eta \rightarrow \pi^+\pi^-\gamma$, $\omega \rightarrow \pi^0\gamma$, $\omega \rightarrow \pi^0\pi^0\gamma$, and $\chi^0 \rightarrow \rho\gamma$; the emission of a lepton–antilepton pair ρ, ω, $\varphi \rightarrow e^+e^-$, $\mu^+\mu^-$; the emission of hadrons such as $\eta \rightarrow \pi^+\pi^-\pi^0$, $\eta \rightarrow 3\pi^0$, and $\omega \rightarrow \pi^+\pi^-$. The problems involved are examined and the various analytical methods used are presented. The implications of these electromagnetic processes are examined in detail from the following points of view: the conservation laws and the quantum numbers assigned, the SU(3) symmetry, and the various theoretical dynamic models. (France)

16254 SIMPLE APPROACH TO THE REGGEISATION OF PHOTOPRODUCTION. Leader, E. (Westfield Coll., London). Acta Phys. Austr.; Suppl. 8, 21-49(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

The Reggeization of photoproduction is considered in the reaction $\gamma + p \rightarrow \pi^+ + n$. It is shown that gauge invariance together with the absence of fixed poles in the complex J-plane is sufficient to give an essentially unique scheme for Reggeization. First spinless nucleons then real spin-$\frac{1}{2}$ nucleons are discussed. (J.F.P.)

16255 PION PHOTOPRODUCTION IN THE REGION OF THE $\Delta^-(1230)$ RESONANCE. Schwela, D. (Univ., Bonn). Springer Tracts Mod. Phys.; 59: 27-38(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

An energy independent phenomenological multipole analysis is made for π^0 and π^+ photoproduction on protons in the region of the $\Delta(1236)$. A comparison is made with dispersive calculations. (J.F.P.)

16256 PHOTOPRODUCTION OF VECTOR MESONS. Wolf, Guenter (DESY, Hamburg). Springer Tracts Mod. Phys.; 59: 77-113(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

The experimental data on the reactions $\gamma + p \rightarrow p + \rho^0$ and $\gamma + p \rightarrow p + \omega(\phi)$ is discussed and compared with various vector dominance model predictions. (J.F.P.)

16257 CURRENT AMPLITUDES IN DUAL RESONANCE MODELS. Ademollo, M. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Springer Tracts Mod. Phys.; 59: 135-53(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

A review is given of attempts to extend the dual resonance model to include the weak and electromagnetic interactions of hadrons. (J.F.P.)

16258 LOW ENERGY PHOTO AND ELECTROPRODUCTION, MULTIPOLE ANALYSIS BY CURRENT ALGEBRA COMMUTATORS. Verzegnassi, C. (Univ., Trieste, Italy). Springer Tracts Mod. Phys.; 59: 154-63(1971).

From Symposium on meson-, photo-, and electroproduction at low and intermediate energies; Bonn (21 Sep 1970).

Previous work on the analysis using current algebra equal time commutation relations saturated in the Breit frame of two external nucleons for low energy photo and electroproduction of pions on nucleons is reviewed. (J.F.P.)

16259 INELASTIC LEPTON–NUCLEON SCATTERING AND LEPTON PAIR PRODUCTION IN THE RELATIVISTIC QUARK–PARTON MODEL. Kuti, Julius; Weisskopf, Victor F. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 4: No. 11, 3418-39(1 Dec 1971).

The interaction of hadrons with leptons in the limit of large momentum transfer is discussed. A special parton model is used for the hadrons in which the partons are identified with quarks. The relativistic quark model is formulated as follows: (1) The baryons are composed of three valence quarks and a core of an indefinite number of quark-antiquark pairs. (2) The lepton "sees" the nucleon in the limit of large momenta in the c.m. frame as an assembly of freely moving constituents with point charges. (3) The scattering of the valence quarks is interpreted as the nondiffractive component, the scattering of the core is interpreted as the diffractive component of the cross section. (4) The nondiffractive scattering is assumed to be mediated by suitable meson exchanges, and this assumption determines the momentum distribution of the valence quarks. The (qq) pairs in the core are assumed to be distributed statistically in the available phase space. (5) It will be necessary to include "gluons" among the constituents of the nucleon. They are supposed to be the uncharged quanta of the force field between quarks and are assumed to be distributed statistically over the momentum space. There is only one constant adjustable in this model, which is the ratio of gluons to core pairs. All other constants are fixed by simple considerations. This model is used to calculate the deep-inelastic scattering of electrons by protons and neutrons and its dependence on the relative spin orientations, the inelastic scattering of neutrinos by nucleons, and the creation of massive muon pairs by proton-proton collisions. After adjusting the open constant to the data of electron-proton scattering, the theory predicts unambiguously the other results. They are in reasonably good agreement with the observations as far as they are known. (auth)

16260 VECTOR-MESON EFFECTS IN THE ELECTRIC FORM FACTOR OF ^{3}He. Lehman, Elliot (Stanford Univ., Calif.). Phys. Rev., D; 4: No. 11, 3324-30(1 Dec 1971).

Assuming vector-meson dominance of ^{3}He elastic scattering, double-impulse "shadowing" corrections, similar to those discussed for deuterium by Gunion and Blankenbecler are calculated. The corrections are too small to account for the high-momentum-transfer structure of the electric form factor. The possibility of double counting of the Born terms for these processes are discussed and it is found that, even using this possibility, the corrections cannot simultaneously account for the form-factor dip at 11.8 F^{-2} and the behavior at higher momentum transfer. The tentative conclusion reached is that the high-momentum-transfer behavior ($10 < \Delta^2 < 20$ F^{-2}) of the ^{3}He electric form factor is caused by high-momentum components of the wave function generated directly by the strong interactions, rather than being of electromagnetic origin. (auth)

16261 ABSOLUTE CALCULATION OF $K^+ \rightarrow \pi^+\pi^0$ DECAY. Chen, J.; Mathur, V. S. (Univ. of Rochester, N. Y.). Phys. Rev., D; 4: No. 11, 3511-14(1 Dec 1971).

Starting with the usual Cabibbo form of the current-current theory of weak interactions, an absolute rate for $K^+ \rightarrow \pi^+\pi^0$ is calculated. Accepting the criticism of Lee against the soft-pion analysis, the soft-kaon limit is analyzed. The extrapolation to the physical point is then performed using a recent suggestion of Okubo and Mathur. (auth)

16262 COMMENTS ON THE UNITARITY BOUND IN $K_L^0 \rightarrow \mu^+\mu^-$. Chen, H. H.; Kawarabayashi, K.; Shaw, L. (Univ. of California, Irvine). Phys. Rev., D; 4: No. 11, 3514-18(1 Dec 1971).

Two alternatives to reconcile the present disagreement between experiment and the "simple" unitarity bound in $K_L^0 \rightarrow \mu^+\mu^-$ are considered. These alternatives presume that CP violation does not play the dominant role (via Reϵ) in the resolution of this puzzle. They are (1) the introduction of new muonic interactions, and (2) the existence of a new pseudoscalar meson. The first alternative can already be eliminated by present experimental evidence. The second alternative must satisfy a number of restrictions. (auth)

16263 SCALING BEHAVIOR NEAR THRESHOLD. Brandt, Richard A. (New York Univ., N. Y.); Preparata, Giuliano. Phys. Rev., D; 4: No. 11, 3522-3(1 Dec 1971).

It is pointed out that the requirement that the leading light-cone singularity be the most important, even at relatively small values of q^2 and ν (precocious asymptopia), leads to the introduction of a

new scaling variable which is similar but not identical to the variable $\omega' = -q^2(2\nu + M^2)^{-1}$. (auth)

16264 VIRTUAL PHOTON–PHOTON ANNIHILATION AND THE PION MASS DIFFERENCE. Yan, Tung-mow (Cornell Univ., Ithaca, N. Y. Standord Univ., Calif.). Phys. Rev., D; 4: No. 11, 3523-6(1 Dec 1971).

On the basis of current algebra and partial conservation of axial-vector current, a sum rule is derived which relates the electromagnetic pion mass difference to the differential cross section for charged-pion pair production near the threshold through virtual photon–photon annihilation in electron–electron (positron) collisions. (auth)

16265 LOW-ENERGY THEOREM FOR $\gamma + \gamma \rightarrow \pi + \pi + \pi$. Adler, Stephen L.; Lee, Benjamin W.; Treiman, S. B. (National Accelerator Lab., Batavia, Ill.). Phys. Rev., D; 4: No. 11, 3497-3501(1 Dec 1971).

The hypothesis of the partially conserved axial-vector current (PCAC) is used to show that the matrix elements for $\gamma + \gamma \rightarrow \pi^0 + \pi^0 + \pi^0$ and $\gamma + \gamma \rightarrow \pi^0 + \pi^+ + \pi^-$ vanish in the soft-π^0 limit. This, combined with photon gauge invariance, implies low-energy theorems relating these matrix elements to the matrix elements for $\gamma + \gamma \rightarrow \pi^0$ and $\gamma \rightarrow \pi^0 + \pi^+ + \pi^-$. Since the magnitude of the former is determined by the π^0 lifetime, while the ratio of the latter to the former is determined in a model-independent way by isospin and low-energy-theorem arguments, a model-independent prediction for the $\gamma + \gamma \rightarrow \pi + \pi + \pi$ amplitude can be given. The results agree with those of Aviv, Hari Dass, and Sawyer in the neutral case, but not in the charged case. A diagrammatic and effective-Lagrangian interpretation of the formulas which explains the discrepancy is given. (auth)

16266 PION ELECTROPRODUCTION IN THE DEEP INELASTIC REGION AS A MEAN TO MEASURE THE DIMENSION OF CHIRAL-SYMMETRY BREAKING. Burnel, A. (Univ., Liege). Lett. Nuovo Cim.; 2: No. 26, 1358-62(25 Dec 1971).

The main features of the law of conservation of scale dimension on the light cone are briefly reviewed. It is then shown that the leading dimension of the chiral symmetry breaking Hamiltonian can be measured from pion electroproduction differential cross sections in the deep inelastic region. (L.B.S.)

16267 SCALING, PROTON CHARGE, AND FLUX QUANTIZATION. Papini, G. (Univ. of Saskatchewan, Regina). Lett. Nuovo Cim.; 2: No. 26, 1370-2(25 Dec 1971).

The possibility of interpreting the proton charge as quantized magnetic flux and the relation between the quantized flux and scaling are considered. In particular, it is proved that if the magnetic flux generated by the proton current is identified with the proton charge, then scaling follows. Conversely, if scaling is assumed, then the proton magnetic flux coincide. (L.B.S.)

16268 INVESTIGATION OF THE REACTION $ep \rightarrow ep\gamma$ BELOW PION THRESHOLD. Bartel, W.; Buesser, F.-W.; Dix, W.-R.; (and others) (DESY, Hamburg. Univ., Hamburg). Nucl. Phys.; B37: No. 1, 86-92(1971).

The reaction $ep \rightarrow ep\gamma$ was studied between the elastic peak and pion threshold. The data provide an experimental test of higher order radiative corrections. (auth)

16269 SUM RULES FOR PHOTO-PION PRODUCTION. Mallik, S.; Dutta-Roy, B. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys.; B37: No. 1, 226-40(1971).

Sum rules obtained from considering dispersion relations for the invariant amplitudes at fixed t and fixed u are presented for pion-photoproduction off nucleons. These are saturated with low-energy resonances in all channels, viz., N and N^* in s- and u-channels and π, ρ, ω and A_1 in t-channel. The problem of saturation of the sum rules is investigated within the approximation scheme and a criterion for reliable saturation of sum rules in terms of the magnitude of the nucleon contribution is obtained. The sum rules relate interesting electromagnetic properties of the particles in the direct channel to the coupling constants associated with t-channel exchanges. The results are in general agreement with other determinations. (auth)

16270 REGGE MODELS OF FORWARD PION AND ETA PHOTOPRODUCTION. Worden, Robert (California Inst. of Tech., Pasadena). Nucl. Phys.; B37: No. 1, 253-312(1971).

A Regge absorption model is presented which fits all pion and eta photoproduction data for $|t| < 1$, which fits the photoproduction FESR, and uses Regge residues in agreement with all constraints. The model uses poles with NWS zeroes, and uses a black disc form of absorption in which low partial waves are completely absorbed. The absorbed Regge amplitudes show remarkable $\rho - A_2$ and $\pi - B$ exchange degeneracy, and agree well with the FESR, which are written for regularized s-channel helicity amplitudes in order to examine their absorptive zero structure. Models using a conventional form of absorption and models in which the poles do not have NWS zeroes are also examined. It is found that models without NWS zeroes can fit the high energy data, but are unable to fit the sum rules. Since Regge absorption models do not fit the distinctive large-t behavior of the cross sections, fixed-pole models are discussed as a possible explanation of these data, and it is shown that even in fixed pole models, some Regge cuts are necessary. The predictions of the various models are presented for some new experimental quantities which can be measured using simultaneously polarized targets and beams, and a test for A_1 exchange is suggested. (auth)

16271 EXCITED LEPTONS AND THE ANOMALOUS MAGNETIC MOMENTS OF MUON AND ELECTRON. De Rujula, A.; Lautrup, B. (CERN, Geneva). Lett. Nuovo Cim.; 3: No. 2, 49-57(8 Jan 1972).

The possible existence of excited states of the electron and muon and their associated neutrinos is considered. Only the muon case is treated, and it is noted that all formulas can be trivially translated into the electron case. The decays $\nu_\mu^* \rightarrow \mu^- + \pi^+$ and $\mu^* \rightarrow \mu + \gamma$ are discussed. The anomalous magnetic momentum of the electron and muon are found. (J.F.P)

16272 REGGE-POLE ANALYSIS OF ρ PHOTOPRODUCTION AND ρ ELECTROPRODUCTION IN DEEP INELASTIC REGION. Saduraoka, M. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 3: No. 3, 89-94(15 Jan 1972).

A previous formalism to treat photons and neutral vector mesons on the same basis is extended to the case where two different vector particles are involved, and it is shown that a simple Regge parametrization leads to the helicity conservation in ρ^0 photoproduction. Also the ρ^0 production cross section in the deep inelastic e + p scattering region is treated by a scaling Regge pole model. (J.F.P.)

16273 MANIFESTATION OF RADIATIVE CORRECTIONS IN COHERENT γ-RAY SCATTERING IN MATTER. Frolov, G. V. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett.; 38B: No. 1, 35-6(10 Jan 1972).

The Faraday rotation of the γ-ray plane of polarization is shown to result from radiative corrections. The calculated value of the rotation angle is close to the experimental one. (auth)

16274 THERMODYNAMICAL MODEL FOR DEEP INELASTIC ELECTRON–PROTON SCATTERING. Kasahara, T. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 2: No. 25, 1277-81 (18 Dec 1971).

The possibility of interpreting the scaling property of the structure functions in deep inelastic electron–proton scattering by the thermodynamic model is examined. A thermodynamic analogy between the deep inelastic e-p scattering and the inelastic hadron–hadron collisions is found. A parametrization of the structure functions was obtained, which fit the data very well. (L.B.S.)

16275 GENERALIZED VECTOR DOMINANCE AND COMPARISON OF $\bar{p}p$ AND e^+e^- ANNIHILATION INTO TWO PSEUDOSCALAR MESONS. Benvenuti, A.; Cline, D. (Univ. of Wisconsin, Madison). Lett. Nuovo Cim.; 3: No. 2, 83-5(8 Jan 1972). Contract AT(11-1)-881.

The vector dominance model is used to compare the cross sections for the annihilations $e^+ + e^- \rightarrow \pi^+ + \pi^-$ and $\bar{p} + p \rightarrow \pi^+ + \pi^-$. Also the processes $e^+ + e^- \rightarrow K_1^0 + K_2^0$ and $\bar{p} + p \rightarrow K_1^0 + K_2^0$ are discussed. (J.F.P.)

16276 THEORY OF POLARIZATION PHENOMENA IN COMPTON SCATTERING BY ELECTRONS. Bock, P. (Univ., Karlsruhe: Ger. Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys.; A177: No. 1, 289-306(1971).

In Compton scattering by electrons there are some correlations between the electron spin and the photon polarization which disappear in the lowest-order Born approximation of quantum electrodynamics. All effects of this type involving knowledge of the photon and electron polarization in the initial state and a measurement of the photon polarization in the final state were calculated numerically in the order α. The results were compared with recent experimental data for Compton scattering of γ-rays by magnetized iron targets. (auth)

16277 t-CHANNEL DESCRIPTION OF DEEP INELASTIC ELECTROPRODUCTION. Pallua, S.; Renner, B. (Univ., Hamburg). Phys. Lett.; 38B: No. 2, 105-6(24 Jan 1972).

Attention is drawn to the fact that a description of deep inelastic electroproduction in terms of nonexotic t-channel exchanges puts

stringent constraints on the data. It puts a bound on the ratio of neutron and proton structure functions $|F_{\gamma N}(\omega)/F_{\gamma P}(\omega)| \geq 1/4$, equality being reached with asymptotically vanishing contributions from SU_3 decuplet nucleon resonances in the direct channel. Further implications on the Drell-Yan relation between the asymptotic behavior of the nucleon electromagnetic form factor and the dependence of the nucleon structure function on the Björken scaling variable near threshold are found. (auth)

16278 SIZE OF PHOTONS. Nieh, H. T. (CERN, Geneva). Phys. Lett.; 38B: No. 2, 100-4(24 Jan 1972).

An attempt is made to clarify the question of the effective size of a photon on the basis of a physical picture which has been found useful in understanding the "shadowing" effects in nuclear photoprocesses and the diffractive features in both high energy nucleonic photoprocesses and large $\omega \equiv 2M\nu/Q^2$ nucleonic electroproductions. The result is in contradiction with the result of Cheng and Wu's model calculation and with the formal estimate of important space-time regions, in the large ω region. Origins of this disagreement are analyzed. (auth)

16279 SUPERSELECTION RULE FOR MAGNETIC CHARGES AND THE SEARCH FOR MAGNETIC MONOPOLES. Barut, A. O. (Univ. of Colorado, Boulder). Phys. Lett.; 38B: No. 2, 97-9(24 Jan 1972).

It is shown that (a) one can construct a quantum mechanics of particles with electric and pseudoscalar magnetic charges in which parity and time reversal are conserved, (b) in a chiral invariant and parity invariant theory there is no superselection rule for magnetic charges, (c) the states which are superpositions of positive and negative magnetic charges, $|g\rangle \pm |-g\rangle$, in which the expectation value of the magnetic charge vanishes, cannot be split in electromagnetic interactions by energy measurements. The hypothesis that magnetic charges occur in the superpositions $|+g\rangle \pm |-g\rangle$ can possibly be tested. (auth)

16280 MESON DISTRIBUTIONS IN PHOTOPRODUCTION. Jacob, M.; Slansky, R.; Wu, C. C. (Yale Univ., New Haven). Contract AT(30-1)-2726. Phys. Lett.; 38B: No. 2, 85-9 (24 Jan 1972). (YALE-2726-619).

Extension of the nova model is applied to $\gamma + p \rightarrow \pi +$ anything. The concept of a photon nova is motivated from vector dominance, and the parameters describing the production of photon novas are estimated from hadron results. The model is essentially without arbitrary parameters. Comparison is made with inclusive and exclusive data at 9.3 GeV/c, where excellent agreement is found. Predictions for 20 GeV/c are also presented. (auth)

Weak

16281 (COO-3067(2)-2) KINEMATIC DISTRIBUTIONS FOR ELECTRON PAIR PRODUCTION BY MUONS. Linsker, Ralph (Columbia Univ., New York. Dept. of Physics. National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1971]. 52p. Dep. NTIS.

Cross sections and kinematic distributions for the trident production process $\mu^\pm + Z \rightarrow \mu^\pm + e^- + e^+ + Z$ (with Z = p and Fe) are given for beam energies of 100 to 300 GeV at fixed (e^-e^+) masses from 5 to 15 GeV. This process is interesting as a test of quantum electrodynamics at high energies, and in particular as a test of the form of the photon propagator at large timelike (four-momentum)^2. For this purpose, it is desirable to impose kinematic cuts that favor those Bethe-Heitler graphs which contain a timelike photon propagator. It is found that there are substantial differences between the kinematic distributions for the full Bethe-Heitler matrix element (which involves four graphs) and the distributions for the two timelike-photon graphs alone; these differences can be exploited in the selection of appropriate kinematic cuts. The competing virtual Compton process (for Z = p) has been estimated on the basis of a simple model; its cross section is at least two orders of magnitude smaller than the Bethe-Heitler cross sections of interest, at the energies and (e^-e^+) masses considered. (auth)

16282 (JINR-E2-6180) BOUNDS FOR K_{l3} DECAY PARAMETERS. Micu, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 12p. Dep. NTIS (U. S. Sales Only).

The extremum of the integral $\int_1^\infty f(x)|F(x)|^2dx$, is determined for the case when the values taken by the function F(x) at three points are known. The result is applied to the K_{l3} problem, the function F(x) being replaced by the form factor $f_+(q^2) + f_-(q^2)q^2/(m_k^2 - m_\pi^2)$ of the divergence of the strangeness changing vector current. (auth)

16283 (JINR-P1-6164) TRANSMISSION REGENERATION OF NEUTRAL K MESONS ON HYDROGEN IN THE MOMENTUM REGION OF 14 TO 42 GeV/c. Birulev, V. K.; Vovenko, A. S.; Vestergombi, D.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The measurements of the transmission regeneration amplitude on hydrogen in the momentum region of 14 to 42 GeV/c indicate that in accordance with the Pomeranchuk theorem its magnitude $|f^0 - \bar{f}^0|/k$ decreases with energy increase and the phase is approximately constant and equal to $\arg(f^0 - \bar{f}^0) = (-118 \pm 13°)$. (auth)

16284 (NYO-3829-76) POSSIBILITY OF OBSERVING ANOMALOUS INTERACTIONS IN HIGH ENERGY ELASTIC SCATTERING OF MUONS. Winternitz, P. (Pittsburgh Univ., Pa. Dept. of Physics). [1971]. Contract AT(30-1)-3829. 22p. (CONF-710933-2). Dep. NTIS.

From Muon physics conference; Fort Collins, Colo. (6 Sep 1971).

The possibility of studying polarization phenomena in high energy lepton scattering to detect possible anomalous interactions of leptons, in particular muons, is discussed. Two types of interactions are considered: A possible weak strangeness conserving interaction, due to a neutral $\Delta S = 0$ current, which would lead to parity violations in high-energy lepton-proton scattering. A possible interaction, having a scalar, pseudoscalar or tensor character, e.g., an interaction between the muon and a scalar boson. Such an interaction, previously suggested to explain the large mass of the muon, would lead to a violation of lepton helicity conservation in the $m/E \rightarrow 0$ limit, whereas in electromagnetic and V-A weak interactions lepton helicity is a good quantum number in this limit (in any order of perturbation theory). Finally comments are made on the complete experiment for lepton-proton scattering. Complications, due to the fact that high energy beams of muons are a priori longitudinally polarized and that this polarization cannot be simply reversed or switched off, are considered in detail. (auth)

16285 (UR-875-366) COMMENTS ON SOME FOUR-BODY K_L^0-DECAYS. Bace, M.; Okubo, S. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 6 Dec 1971. Contract AT(30-1)-875. 7p. Dep. NTIS.

It is pointed out that the (yet unmeasured) decay modes $K_{L,S}^0 \rightarrow \pi^+\pi^0 e^-\nu$ can be used to distinguish between the p-wave $\pi^+\pi^-$ scattering parameters of $K^+ \rightarrow \pi^+\pi^- e^+\nu$ decay. Also, the possibility of measuring CP-violation in $K_L^0 \rightarrow e^+e^-e^+e^-$ decay is discussed. (auth)

16286 (UR-875-367) RELATIONS AMONG THE STRUCTURE FUNCTIONS OF DEEP INELASTIC NEUTRINO NUCLEON SCATTERING. Dicus, Duane A. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 7 Dec 1971. Contract AT(30-1)-875. 14p. Dep. NTIS.

Lightcone current commutators are used to derive relations between the structure functions of the vector-vector part of neutrino nucleon scattering and the structure functions of the vector-axial vector part. (auth)

16287 NON-LOCAL APPROACH TO WEAK INTERACTIONS. Pietschmann, H. (Univ., Vienna). Acta Phys. Austr.; Suppl. 8, 121-35(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

The lectures cover a summary of possible realizations of the structure tensor, calculations for the decay $K_1^0 \rightarrow \mu + \bar{\mu}$, and other nonlocal models. The process $\mu^- + \nu_e \rightarrow e^- + \nu_\mu$ is also discussed. (J.F.P.)

16288 RENORMALIZABLE DECEPTION THEORY OF WEAK INTERACTIONS. Kummer, W. (Oesterreichische Akademie der Wissenschaften, Vienna. Technische Hochschule, Vienna). Acta Phys. Austr.; Suppl. 8, 136-53(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

The very general conditions under which a nonlocal theory of weak interactions with a renormalizable Lagrangian yields the effective V-A-form for the leptons in leptonic and semileptonic matrix elements are reviewed. The simplest special case is the two-boson exchange model, when both particles have spin zero. After several attempts to elaborate this model so as to avoid qualitative contradictions in the realm of nonleptonic processes by the introduction of several other particles, in its most recent version by Gupta and Patil even less particles are required than in the original box model for leptonic and semileptonic processes. Also the last basic open question is treated, namely the incorporation of the CVC-hypothesis, by the assumption of a product de-

velopment of the hadronic source-operators in the hadronic part, and in this way a satisfactory solution is found. It seems unreasonable to go any further in the theory at the moment, when experimental knowledge about the nonlocal structure of weak interactions is still nonexistent. (auth)

16289 CHIRAL-SYMMETRY-BREAKING EFFECTS ON NEUTRINO SCATTERING. Lee, Benjamin W.; Mandula, Jeffrey E. (California Inst. of Tech., Pasadena). Phys. Rev., D; 4: No. 11, 3475-81(1 Dec 1971).

The ideas of approximate scale invariance and operator light-cone expansions are used to relate inelastic neutrino scattering form factors to the one-nucleon matrix elements of double commutators of chiral (weak) charges with the Hamiltonian, $\langle N|[Q, [Q\dagger,\mathcal{H}]]|N\rangle$. Two kinds of sum rules are given, one expressing the finiteness of the commutator, the other its connection to neutrino scattering. It is pointed out that these sum rules can, in principle, be directly evaluated from measurable form factors. (auth)

16290 TEST OF K_{l3} SOFT-PION THEOREM AND CHIRAL SW(3) MODEL. Shih, I.-Fu; Okubo, Susumu (Univ. of Rochester, N. Y.). Phys. Rev., D; 4: No. 11, 3519-21(1 Dec 1971).

An exact inequality involving the K_{l3} scalar form factor D(t) and its derivatives is derived by utilizing the soft-pion theorem. From our analysis, the chiral SW(3) model of Gell-Mann, Oakes, and Renner and of Glashow and Weinberg appears to be inconsistent with the present experimental data. The linear extrapolation method for D(t) is also shown to lead to an inconsistent result. (auth)

16291 RADIATIVE CORRECTIONS TO THE $\Sigma \to \Lambda e^+e^-$ DECAY. Sidhu, Deepinder P.; Smith, Jack (State Univ. of New York, Stony Brook). Phys. Rev., D; 4: No. 11, 3344-9(1 Dec 1971).

At present, nothing is known experimentally about the slope of the dominant form factor in the decay $\Sigma \to \Lambda e^+e^-$. However, it is probably so small that radiative corrections to the decay are an essential complication. The soft-photon radiative corrections to the Dalitz plot and the spectrum in the mass of the electron–positron pair are calculated. The correction to the total decay rate involving hard photons is also evaluated. (auth)

16292 RESONANCE FORMATION IN HIGH-ENERGY NEUTRINO SCATTERING. Albright, C. H. (Northern Illinois Univ., Dekalb); Good, R. H. Jr. Phys. Rev., D; 4: No. 11, 3299-3312 (1 Dec 1971).

Nonlocal effects associated with spin-1 resonance formation in high-energy neutrino scattering are studied in some detail. The breaking of lepton locality through resonance formation introduces the standard Breit–Wigner factor as well as additional momentum dependence through invariant momentum products and form factors at the formation and decay vertices. Exchange of a lepton–baryon resonance in antineutrino scattering leads to the prediction that the asymptotic antineutrino and neutrino cross sections are unequal. The formalism developed is applied to the Yoshiki effect and to a hypothetical lepton–baryon resonance at 10 GeV. Present data indicate the former effect is at best superweak while the latter appears to be no stronger than one-tenth the weak-interaction strength in the energy region ω_ν(lab) $\lesssim$ 5 GeV. (auth)

16293 WEAK PRODUCTION OF NUCLEON RESONANCES. Zucker, P. A. (Univ. of Oregon, Eugene). Phys. Rev., D; 4: No. 11, 3350-87(1 Dec 1971).

A dynamical and fully covariant model is presented for the weak production from nucleons of the N*(1236) and higher-mass resonances. The analytic structure and unitarity of the partial-wave helicity amplitudes are incorporated in this model which has a simple N/D form. Above the $\pi\pi$N threshold, the excitation and rescattering of hadronic eigenstates are considered. For the excitation mechanism pion, nucleon, and vector–meson exchange are used. By using the conserved vector-current theory and a previous calculation for electroproduction, all the necessary normalizations, which result from the final-state enhancement factors are ascertained beforehand, and thereby an absolute calculation for weak production is performed. Predictions are given for the differential and total cross sections in the first four resonance regions, and a favorable comparison is made with the existing data from CERN. The results for the N*(1236) are considerably different from the predictions made by Adler in a calculation which treats that one resonance. Since the cross-section formulas are derived keeping all dependence on the lepton mass, the interesting behavior can be examined as the forward direction is approached. The partially conserved axial-vector current hypothesis, its implications for resonance production, and the role of the model in designing a test of it are also discussed. (auth)

16294 NONLEPTONIC KAON DECAYS, CURRENT ALGEBRA, AND GENERALIZED VENEZIANO MODEL. Hosoya, Akio; Tokuda, Naoki (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1491-1500(Nov 1971).

Nonleptonic kaon decays are investigated in a generalized Veneziano model. Decay amplitudes, which are constructed under the conditions that they should contain no exotic resonance and satisfy current-algebra relations, obey the $|\Delta I| = \frac{1}{2}$ rule automatically. Numerical results agree with experiment. (auth)

16295 DECAY $K_L \to 2\mu$ AND POSSIBLE CPT VIOLATION. Bogomolnyi, E. B.; Dolgov, A. D.; Okun, L. B.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 38B: No. 1, 45-6(10 Jan 1972).

A very weak violation of CPT invariance could explain observed suppression of the decay mode $K_L^0 \to \mu^+\mu^-$. Some other possible manifestations of such violation are discussed. (auth)

16296 NEUTRINO PRODUCTION OF HEAVY NEUTRAL LEPTONS. Albright, C. H. (Stanford Univ., Calif.). Lett. Nuovo Cim.; 3: No. 2, 71-4(8 Jan 1972).

Some theoretical speculations on neutral-heavy lepton production by ν_μ are presented considering the processes $\nu_\mu + p \to p +$ heavy lepton and the heavy lepton decay into $\pi^+ + \mu^-$. The production cross sections are found and also partial decay rates for this decay and several others. The branching ratio for heavy lepton decay into $\pi^0 + \nu_\mu$ is also found. According to this analysis the charged-current coupling is greatly enhanced relative to the neutral-current coupling of heavy leptons. The universal charged-current coupling strength g = 1 is ruled out in this model. This casts doubt on the validity of the observed effect. (J.F.P.)

16297 INTERMEDIATE W-BOSON IN UNDERGROUND EXPERIMENTS. Bergamasco, L.; Castagnoli, C.; D'Ettorre Piazzoli, B.; Picchi, P. (CNR, Turin, Univ., Turin). Lett. Nuovo Cim.; 2: No. 25, 1326-33(18 Dec 1971).

The depth dependence of the ratio R of stopping to through mesons was carried out in the M. Blanc Station (~4300 m w.e.) as a means for studying new leptonic interactions related to the existence of the intermediate W-boson. A value of R higher than that expected from the residual of the atmospheric muon component was obtained. An attempt is made to verify the sensitivity of the underground experiments to the existence of W as a function of its mass M_W through the following processes: neutrino–nucleus collision; real W production; and production of strongly interacting W. A plausible interpretation of the results of the stopping-muon experiment is also discussed. (L.B.S.)

16298 COMMENTS ON THE $K_s \to l\bar{l}\gamma$ DECAY. Miyazaki, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 2: No. 25, 1323-5 (18 Dec 1971).

The predominance of the $K_s \to l\bar{l}\gamma$ decays over the $K_s \to l\bar{l}$ decay is shown. The ratios to $\Gamma(K_s \to \gamma\gamma)$ are predicted. (L.B.S.)

16299 TEST OF THE NAIVE UNITARITY BOUND IN $K_L^0 \to \mu^+\mu^-$. Trofimenkoff, N. N. (Univ. of Calgary, Alta.). Lett. Nuovo Cim.; 2: No. 25, 1292-4(18 Dec 1971).

It is pointed out that the decay $\eta \to \mu^+\mu^-$ can be used to provide a partial test of the validity of neglecting the processes $K_2^0 \to \pi^+\pi^-\gamma \to \mu^+\mu^-$ in establishing a unitarity bound for $\Gamma(K_2^0 \to \mu^+\mu^-)$. (L.B.S.)

16300 CALCULATION OF PARAMETERS FOR K^0–K^0 SYSTEM. Da Silveira, Adel (Colegio Pedro II and Nucleo de Estudos e Pesquisas Cientificas, Rio de Janeiro). An. Acad. Brasil. Cienc.; 43: No. 1, 57-61(Mar 1971).

The method of Gronau is used in the calculation of the parameters for K^0–$\bar{K}^0$ decay with the help of the value of the phase difference $\delta_2 - \delta_0$ found by Marateck as well as the value of $|\delta_2 - \delta_0|$ obtained by Morfin and Sinclair. It is shown that the calculated $\eta_\pm$ and η_{00} phases agree with the experimental ones, in view of the appreciable error involved in the experimental measurements. The real part of ϵ is calculated and the result is compared with the values presented in the existing literature. It is shown also that the modulus of η_{00} has the acceptable value in one of the cases considered. In this case, however, the value of Re_ϵ is in complete disagreement with the experimental values reported by Dorfan, Fitch and Bennett. (auth)

Strong (General)

Refer also to abstracts 16057 and 16847.

16301 THEORY AND PRACTICE OF COMPLEX REGGE POLES. Zachariasen, F. (CERN, Geneva). Acta Phys. Austr.; Suppl. 8, 50-90(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

The discussion of complex Regge poles covers the form of the t-channel partial wave amplitude and the form of the scattering amplitude at high energy. Applications are given for various strong interactions. (J.F.P.)

16302 MULTIPARTICLE DUAL MODEL. Drummond, I. (Cambridge Univ., Eng.). Acta Phys. Austr.; Suppl. 8, 91-120 (1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

Lectures on the principle of duality for strong interaction amplitudes are given. The five-point and the N-point functions, factorization, Koba-Nielsen variables, gauge conditions, and general gauge conditions and the elimination of ghosts are treated. (J.F.P.)

16303 NON-LOCAL FIELD THEORY APPROACH TO STRONG INTERACTION DYNAMICS. Nilsson, J. (Inst. of Theoretical Physics, Goteborg). Acta Phys. Austr.; Suppl. 8, 154-76(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

Lectures are given on the question of what kind of realization one should use for the Poincare group for the construction of fields. The choice of carrier space, homogeneous spaces of $\bar{P}$, a parametrization of $\bar{P}$, construction of unitary irreducible representations of $\bar{P}$ with H as a carrier space, an alternative point of view, free fields defined on $\bar{P}/N$, and the free field propagator function are considered. (J.F.P.)

16304 INCLUSIVE PROCESSES AT HIGH TRANSVERSE MOMENTUM. Berman, S. M.; Bjorken, J. D.; Kogut, J. B. (Stanford Univ., Calif.). Phys. Rev., D; 4: No. 11, 3388-3418 (1 Dec 1971).

The distribution of secondary particles C in processes A + B → C + anything at very high energies is calculated when (1) particle C has transverse momentum p_T far in excess of 1 GeV/c, (2) the basic reaction mechanism is presumed to be a deep-inelastic electromagnetic process, and (3) particles A, B, and C are either leptons (l), photons (γ), or hadrons (h). It is found that such distribution functions possess a scaling behavior, as governed by dimensional analysis. Furthermore, the typical behavior even for A, B, and C all hadrons, is a power-law decrease in yield with increasing p_T, implying measurable yields at NAL of hadrons, lepton, and photons produced in 400-GeV pp collisions even when the observed secondary-particle p_T exceeds 8 GeV/c. There are similar implications for particle yields from e^+-e^- colliding-beam experiments and for hadron yields in deep-inelastic electroproduction (or neutrino processes). Among the processes discussed in some detail are ll → h, $\gamma\gamma$ → h, lh → h, γh → h, γh → l, as well as hh → l, hh → γ, hh → W, and W → h, where W is the conjectured weak-interaction intermediate boson. The basis of the calculation is an extension of the parton model. The new ingredient necessary to calculate the processes of interest is the inclusive probability for finding a hadron emerging from a parton struck in a deep-inelastic collision. This probability is taken to have a form similar to that generally presumed for finding a parton in an energetic hadron. The dependence of the conclusions on the validity of the parton model is studied, and it is concluded that they follow mainly from kinematics, duality arguments à la Bloom and Gilman, and the crucial assumption that multiplicities in such reactions grow slowly with energy. The picture obtained generalizes the concept of deep-inelastic process, and the existence of "multiple cores" in such reactions is predicted. Speculations are made on the possibility of strong, nonelectromagnetic deep-inelastic processes. If such processes exist, the predictions of particle yields for hh → h could be up to 4 orders of magnitude too low, and for γh → h and hh → γ up to 2 orders of magnitude too low. (auth)

16305 MULTIPERIPHERAL MODEL FOR POMERANCHUKON COUPLINGS. Carlitz, R.; Green, M. B.; Zee, A. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 4: No. 11, 3501-6(1 Dec 1971).

An intimate connection between the Pomeranchukon and the f and f' Regge trajectories is derived in the context of a specific multiperipheral model, embodying duality. The explicit dependence of the Pomeranchukon couplings of the f (and f') Regge poles clarifies certain features of diffraction scattering data. (auth)

16306 PRODUCTION OF STRANGE PARTICLES AND THE f' AND phi REGGE TRAJECTORIES. Snider, Dale R. (Univ. of Wisconsin, Milwaukee). Phys. Rev., D; 4: No. 11, 3506-7 (1 Dec 1971).

A natural implication of introducing strangeness into the multiperipheral model is the existence of a pair of nearly exchange-degenerate Regge trajectories which couple primarily to $K\bar{K}$ and only slightly to $\pi\pi$ states, i.e., the f' and ϕ trajectories. This fact helps to determine the small role of strangeness exchange in generating the Pomeranchukon. (auth)

16307 OPTICAL MODEL FOR DIFFRACTION DISSOCIATION. Pumplin, Jon (Michigan State Univ., East Lansing). Phys. Rev., D; 4: No. 11, 3482-7(1 Dec 1971).

The "Deck effect" is generalized to include multiple scattering, which should be important in diffractive dissociation on nuclear targets. A simple and intuitively appealing optical (eikonal) representation is given. On the basis of this representation, it is conjectured that form-factor effects should be included as a function of the distance off the energy shell in old-fashioned perturbation theory, at "infinite" momentum, rather than as a function of the distance off the mass shell, as in the usual double-Regge models. Ways to test this conjecture are discussed, and a procedure is given for including absorptive effects in 2 → 3 processes. (auth)

16308 EXCHANGE-CURRENT RADIATION MODEL FOR INCLUSIVE SPECTRA AND ELASTIC SCATTERING. Arnold, Richard C. (Argonne National Lab., Ill.). Phys. Rev., D; 4: No. 11, 3488-96(1 Dec 1971).

A semiclassical, geometrical model for high-energy hadron collisions is proposed which incorporates multiparticle unitarity. The model leads to asymptotically constant elastic and total cross sections (fixed Pomeranchuk pole at J = 1), together with logarithmically increasing average multiplicities. A specific phenomenological form of the hadronic current distribution, first used by Heckman, is found to give very good agreement with single-particle inclusive spectra with no adjustable parameters. Correlation functions are not present in this model. (auth)

16309 PHENOMENOLOGY IN PARTICLE PHYSICS 1971. Proceedings of the Conference Held at Pasadena, California, March 25-26, 1971. Chiu, C. B.; Fox, G. C.; Hey, A. J. G. (eds.). Pasadena, Calif.; California Institute of Technology (1971). 827p. (CONF-710309).

The conference included 23 papers one of which was abstracted previously in NSA. For an abstract of this paper see abstract number 25: 28003. Separate abstracts were prepared for 22 papers. (J.F.P.)

For abstracts of individual papers see: 16213-16224, 16310-16314, 16331, 16332, and 16348-16350.

16310 PHENOMENOLOGY OF MULTIPARTICLE REACTIONS. Frazer, William R. (Univ. of California, San Diego, La Jolla). pp 48-82 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Strong interactions are treated. The organization of the data and the abstraction of qualitative behavior from existing models are considered. (J.F.P.)

16311 PHENOMENOLOGICAL APPLICATIONS OF DUAL MODELS. Berger, Edmond L. (Argonne National Lab., Ill.). pp 83-223 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A thorough critical appraisal of practical uses made of dual models in the analysis of strong interactions is presented. Four-point phenomenology, B_5 phenomenology, and dual models for diffraction dissociation are reviewed. The scope of published results is extended where appropriate to show more clearly their physical significance. (J.F.P.)

16312 PHENOMENOLOGY AT INTERMEDIATE ENERGIES. Schmid, Christoph (CERN, Geneva). pp 629-67 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Regge pole theory for strong interactions at intermediate energies is reviewed. The significance of intermediate energy experiments for Reggeology, the confrontation of the Regge de-

scription with the phase shift description in K^+p scattering, the geometrical picture, the new interference model, phase band method, and K^-p backward scattering are discussed. (J.F.P.)

16313 PRESENT AND FUTURE OF TWO-PARTICLE PHENOMENOLOGY. Lovelace, C. (Rutgers–The State Univ., New Brunswick, N. J.). pp 668-702 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A review is given of the pattern emerging from strong interaction phenomenology. Resonances on the average, resonances viewed locally, Regge cuts, the dip mechanism, the pomeron, photoproduction, and exotic mesons and nuclear forces are considered. (J.F.P.)

16314 IMPORTANCE OF BEING AN AMPLITUDE. Fox, Geoffrey C. (California Inst. of Tech., Pasadena). pp 703-814 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

The theoretical and experimental understanding of the amplitudes of strong interactions at high energies is reviewed. Emphasis is placed on the study of the t-dependence of the amplitudes. Small and large momentum transfer, the quark model and multiparticle reactions are treated. (J.F.P.)

16315 HOW MUCH OF DIFFRACTION DISSOCIATION CROSS SECTIONS IS DIFFRACTIVE? Cohen-Tannoudji, G. (CEN de Saclay, Gif-sur-Yvette, France); Kane, G. L.; Quigg, C. Nucl. Phys.; B37: No. 1, 77-85(1971).

The possibility that at present energies diffraction dissociation reactions may have a smaller truly diffractive contribution than is usually supposed is discussed. The purpose is to stimulate more critical examination of data, and to change the emphasis of experiments, so that the experimental situation can be clarified more quickly. (auth)

16316 SOME REMARKS ABOUT INCLUSIVE CROSS SECTIONS FROM DUAL MODELS. Corbella, O. D. (Univ. Nacional, Cordoba, Argentina); Gleiser, R. J.; Gallardo, J. C. Nucl. Phys.; B37: No. 1, 241-52(1971).

Using the statistical formalism of dual models, the inclusive cross sections are calculated in the triple Regge limit. This approach allows the multiparticle inclusive cross section to be computed applying the well-known rules used in the construction of tree graphs within the harmonic oscillator formalism. Extrapolating the results to the pionization region ($\rho \gtrsim 1$) the average multiplicity $\langle n(s)\rangle$ is computed finding the experimentally well established ln s behavior. (auth)

16317 CHEW–PIGNOTTI DUALITY AND 1^+ MESONS. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 2: No. 25, 1321-2(18 Dec 1971).

The Chew–Pignotti duality argument is applied to the $\pi-\gamma$ system in the $\pi^-p \to \pi^-\gamma p$ interaction. It is concluded that the peak in the $\pi-\gamma$ mass distribution implies the existence of a resonance having the following quantum numbers: $J^P = 1^+$, $I = 1$, $M \simeq 187$ MeV. (L.B.S.)

16318 FUNDAMENTAL QUARTETS AND CHIRAL U(4) ⊗ U(4). Maki, Ziro; Maskawa, Toshihide (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1647-9(Nov 1971).

Some remarks are given on the basic schemes of hadrons and their symmetries in connection with the concept of a new fourth fundamental baryon. The quartet schemes are reformulated and the possibility that the chiral U(4) ⊗ U(4) symmetry works in the new formulation is suggested. (L.B.S.)

16319 RELATIVISTIC QUANTUM MECHANICS OF ONE-DIMENSIONAL MECHANICAL CONTINUUM AND SUBSIDIARY CONDITION OF DUAL RESONANCE MODEL. Goto, Tetsuo (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1560-9(Nov 1971).

Relativistic quantum mechanics of a finite one-dimensional continuum is studied in the framework of Dirac's generalized Hamiltonian dynamics. It is shown that the wave equation and subsidiary conditions found by Virasoro in the dual resonance model are equivalent to relativistic quantum mechanics in our system. Interaction with external fields is also studied briefly. (auth)

16320 TRIPLE REGGE BEHAVIOR AND ITS PHENOMENOLOGICAL EXTENSION IN INCLUSIVE REACTIONS. Iwao, Syurei (Kanazawa Univ., Japan). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1633-5(Nov 1971).

A model is presented for inclusive interactions which seems to apply down to low energy where the resonance structure of the missing mass spectra is important. Starting with the parameter dependence of the triple Reggeon model the cross section for the inclusive reaction is found in terms of two-particle differential cross sections so as to continue smoothly to the dominant trajectory dependence assumed in that model. The physical consequences of the model are briefly discussed. (L.B.S.)

16321 INCLUSIVE REACTIONS AND URBARYON REARRANGEMENT DIAGRAMS. II. SCALING FORMS FOR SMALL TRANSVERSE MOMENTUM. Kinoshita, Kisei; Noda, Hujio (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1642-4(Nov 1971).

The asymptotic behavior of the single-particle distribution in inclusive interactions is discussed. The relation between the scaling forms for inclusive reactions and the pattern of the flow of urbaryon lines is studied. The explicit scaling forms for each type of URD are found in the region of small momentum transfer. (L.B.S.)

16322 SCALING IN SEMI-INCLUSIVE EXPERIMENTS. Koba, Z.; Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). Phys. Lett.; 38B: No. 1, 25-9(10 Jan 1972).

In bubble chamber experiments (in contrast to counter experiments) the semi-inclusive experiment $a + b \to c + (n-1)$ charged + anything neutral is more natural than the corresponding inclusive experiment $a + b \to c +$ anything. It is argued that the cross sections for semi-inclusive experiments have very neat scaling properties. (auth)

16323 EXOTIC CHANNELS AND APPROACH TO SCALING IN INCLUSIVE REACTIONS. Tye, S.-H. H.; Veneziano, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Phys. Lett.; 38B: No. 1, 30-4(10 Jan 1972).

Inclusive sum rules are used to couple the 2-component theory of total cross sections and a dual theory of single particle spectra. Definite predictions on the way scaling is approached are obtained. They explain available data, including the odd behavior of $\sigma(pp \to K_1 +$ anything). (auth)

16324 DETAILED WAVE EQUATION AND DUAL AMPLITUDE. RELATIVISTIC QUANTUM DYNAMICS OF STRING MODEL OF HADRONS. Takabayasi, Takehiko (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1528-48(Nov 1971).

Relativistic quantum dynamics of a one-dimensional elastic continuum (string) is represented by a "detailed wave equation" which is defined at every point of the string and has local coupling to an external field at the end of string. The actual form of this wave equation is severely determined from its self-consistency, which is guaranteed by the existence of a closed algebra for the "invariant hamiltonian density operator". The algebra in turn directly represents the "gauge invariance" of the theory. The invariant hamiltonian density operator consists of real and imaginary parts, of which the latter represents nonlocal interaction inside the string and exhibits a remarkable Hilbert transform relation. The detailed wave equation is brought to the set of the global wave equation corresponding to the wave equation in the usual sense and an infinite number of subsidiary conditions which work to suppress unphysical states. The unconventional definition of normal mode operators $\{C_\mu^\dagger\}$ enables a uniform treatment of external and internal motions and the factorization of all wave operators into convolutions. The theory leads to dual amplitude for a particular value of intercept. A completely equivalent formulation of theory with the introduction of a proper-time like parameter is also given, which supplies further insights. Finally speculations are made for generalizing the model to more realistic cases. (auth)

16325 SPACE–TIME APPROACH TO THE LATTICE DUAL RESONANCE MODEL. Biyajima, Minoru (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1516-27(Nov 1971).

The Veneziano amplitude (in the sense of Koba–Nielsen) is constructed from the classical-lattice model with the interaction part $\Sigma k_s \delta(t - t_s)$, by the use of the action integral method. The one-loop planar amplitude is also calculated in this model. (auth)

16326 OPERATOR FORMALISM OF THE DUAL RESONANCE MODEL WITH DIFFERENT TRAJECTORIES. Konisi, Gaku (Kwansei Gakuin Univ., Nishinomiya, Japan); Saito, Takesi. Progr. Theor. Phys. (Kyoto); 46: No. 5, 1501-15(Nov 1971).

In the dual resonance model the generalized harmonic oscillator

formalism is constructed when relevant particles lie on different trajectories. Requiring the factorization in the sense of the operator method, one can see that the Regge intercepts are expressed in terms of quark quantum numbers. Propagator, general vertex, gauge operator and so on, appearing in the usual dual resonance model with a single trajectory, are redefined. The duality of the four-point tree diagram between general non-spurious virtual states can also be shown. (auth)

16327 s-CHANNEL DUAL ABSORPTIVE MODEL AS A CONSEQUENCE ALSO OF t-CHANNEL ABSORPTION. Desai, B. R. (Univ. of California, Riverside). Phys. Lett.; 38B: No. 2, 107-9(24 Jan 1972).

The dual absorptive model applied to t-channel predicts that Regge residues above threshold are I_n-functions which for $t \leq 0$, for the leading trajectory, are simply $J_n(R_0\sqrt{-t})$. Thus s-channel absorptive models can be expressed entirely in terms of t-channel quantities. Implications to complex Regge poles are discussed. (auth)

16328 ZERO IN THE THREE POMERON VERTEX. Goddard, P.; White, A. R. (Cambridge Univ., Eng.). Phys. Lett.; 38B: No. 2, 93-6(24 Jan 1972).

Multiparticle unitarity is used to show that a reflection of the two-Pomeron cut in the three Pomeron vertex provides a zero which removes the analogue of the Gribov-Pomeranchuk fixed-pole in the forward limit giving the inclusive cross-section. This cross section then has a linear zero in the momentum transfer arising from the signature factor. (auth)

Strong (Baryon No. = 0)

16329 SOME PROPERTIES OF THE MESONS FROM A RELATIVISTIC SCALAR QUARK MODEL WITH STRONG BINDING. Boehm, M.; Joos, H.; Krammer, M. (DESY, Hamburg). Acta Phys. Austr.; Suppl. 8, 407-15(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

A lecture on the dynamics of strong binding in the framework of relativistic quantum field theory is given in which the mesons as qq systems are described by two-field amplitudes. (J.F.P.)

16330 EFFECTS OF OFF-MASS-SHELL CONTINUATION IN THE MULTIPERIPHERAL MODEL. Avalos, Daniel; Webber, Bryan R. (Univ. of California, Berkeley). Phys. Rev., D; 4: No. 11, 3313-20(1 Dec 1971).

The predictions of the Amati–Bertocchi–Fubini–Stanghellini-Tonin multiperipheral model concerning Regge trajectories and residues are presented for a number of different parametrizations of the off-shell $\pi\pi$ scattering amplitude. The unmodified model, in which the kernel is taken to be the on-shell amplitude, gives unsatisfactory results. The most natural continuation appears to involve the phenomenological form factors of Dürr and Pilkuhn (DP). The use of the DP form factors leads to trajectories with slope about 1 GeV^{-2} and intercepts $\alpha_{I=0} = 0.57$ and $\alpha_{I=1} = 0.36$. When K- and η-meson exchanges are included in the model, the DP form factors provide a sensible way of including bound-state vertices such as $\rho K\bar{K}$ and $K^*K\eta$. The trajectory intercepts are now increased to $\alpha_{I=0} = 0.63$ and $\alpha_{I=1} = 0.42$, and the average multiplicities of the various secondaries are of the form c^n_i, where $c_\pi = 0.84$, $c_K = 0.11$, and $c_\eta \approx 10^{-4}$. It seems possible that this model, in conjunction with the "schizophrenic-Pomeranchon" mechanism, can provide a good description of high-energy processes. (auth)

16331 INTERFERING RESONANCES AND THE A_2 MASS SPECTRUM. Barnham, K. W. J.; Goldhaber, G. (Univ. of California, Berkeley). pp 307-21 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

It is shown that if the simple dipole formula is abandoned and two interfering resonances are considered the A_2^- and A_2^+ spectra can be reconciled. That is, both mass spectra can be fitted with the same mass and width parameters for the two interfering resonances with only small changes in other parameters. (J.F.P.)

16332 THEORETICAL REMARKS ON THE A_2 MESON. Rosner, Jonathan L. (Univ. of Minnesota, Minneapolis). pp 387-419 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

Theoretical aspects of the A_2 and its possible substructure are reviewed. Features of the unsplit A_2, the production mechanism in $\pi + N \rightarrow A_2 + N$ interactions, and the A_2 resonance shape are discussed. (J.F.P.)

16333 CALCULATION OF THE ρ AND Δ TRAJECTORIES. Devenish, R. C. E.; Eilbeck, J. C.; Lyth, D. H. (Univ. of Lancaster, Eng.). Nucl. Phys.; B37: No. 1, 313-35(1971).

The ρ and Δ Regge trajectories are calculated from single particle exchange, with no adjustable parameters. Sensible results are obtained over a limited energy range, except for the imaginary part of the ρ trajectory which is much too large (the inclusion of a CDD parameter brings it down to its correct value). A critical assessment is made of the N/D formalism used, including the CDD question. (auth)

16334 ISOSPIN ANALYSIS OF HADRONIC PRODUCTION PROCESSES AT HIGH ENERGY. Bjoerneboe, J. (Univ. of Copenhagen); Koba, Z.; Toernqvist, N. Nucl. Phys.; B37: No. 1, 212-25(1971).

Consequences of isospin invariance are discussed under usual circumstances of hadronic production processes at high energy; one has to do with a large number (typically three or more) of isospin amplitudes and analyze cross sections which are averaged and summed with respect to helicities and integrated over a certain region of phase space. After such summation and integration the constraints (due to relative phases of the isospin amplitudes), which relate differential cross sections, are lost; but, instead, weaker constraints are obtained in the form of inequalities. General forms of these inequalities and their implications are presented. They are often useful in evaluating upper and lower limits of integrated isospin amplitudes when the number of available charge channels is not sufficient for determining the latter. Examples are given for single-pion production processes with emphasis on the estimation of various isospin exchange mechanisms, in particular that of I = 0 exchange. The method is illustrated by using experimental data from $KN \rightarrow K\pi N$ at 3 GeV/c. (auth)

16335 POSSIBLE VIOLATION OF EXCHANGE DEGENERACY IN $\pi\pi$ SCATTERING. Kaiser, G. (Carleton Univ., Ottawa). Lett. Nuovo Cim.; 2: No. 26, 1373-5(25 Dec 1971).

A continuous-moment sum rules analysis of $\pi\pi$ scattering is reported, using phase shifts obtained from π production data by OPE analysis. Fits to the P′ and ρ trajectories and residues indicate that exchange degeneracy is violated. (L.B.S.)

16336 MECHANISM OF A_1 AND Q PRODUCTION. Barmawi, M. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 2: No. 26, 1353-7(25 Dec 1971).

The analysis of the density matrices of A_1 and Q production is discussed in order to obtain information on the helicity structure and the relative magnitude of the couplings of the contributions of the ρ-f exchange-degenerate trajectory and the pomeron. It is found that the pomeron contributes mainly to the helicity-flip t-channel amplitude and the ρ-f trajectory contributes mainly to the nonflip component of the same amplitude. The coupling strengths are found to be approximately the same in A_1 production. (L.B.S.)

16337 COMMENT ON CHIRAL INVARIANT LAGRANGIAN AND SOFT-PION THEOREMS. Suzuki, Tsuneo (Nagoya Univ., Japan); Uchida, Tomiyoshi; Hattori, Chuichiro. Progr. Theor. Phys. (Kyoto); 46: No. 5, 1485-90(Nov 1971).

In the framework of tree approximation, the soft-pion theorems are shown to hold true even in a general case where 1^+ meson fields are contained in the chiral invariant Lagrangian, which is applicable to hard-pion processes. Thus, contrary to the results of Biswas et al for K_{l4} decays, almost the same results are obtained as those of the soft-pion technique when re-examining their calculations. (auth)

16338 DERIVATION OF SU(3) COUPLINGS, CANONICAL MIXING-ANGLES, AND ABSENCE OF EXOTICS FOR MESONS FROM THE ASSUMPTION OF STRAIGHT-LINE BEHAVIOR OF AMPLITUDE ZEROS. Odorico, R. (Argonne National Lab., Ill.). Phys. Lett.; 38B: No. 1, 37-41(10 Jan 1972).

The bootstrap induced by the assumption of straight-line behavior of amplitude zeros is shown to lead, in (ps)meson-(ps)meson scattering, to absence of exotics and to relations among meson couplings coinciding with those derived from SU3, canonical mixing-angles. Predictions for η and X^0 couplings are also derived and found to provide a nice explanation of existing data. Such predictions appear to clash with quark-model ideas. (auth)

16339 PION–PION SCATTERING LENGTHS AND THE SIGMA-COMMUTATOR. Chan, F. C. P. (Saginaw Valley Coll., Mich.). Lett. Nuovo Cim.; 3: No. 3, 108-10(15 Jan 1972).

A slightly different approach than that previously used for a derivation of the pion–pion scattering lengths in the framework of current algebra is given. In the approach used one deals directly with the amplitude on the mass shell in the final analysis. (J.F.P.)

16340 KSFR SUM RULE. Ecker, G. (CERN, Geneva). Lett. Nuovo Cim.; 2: No. 25, 1287-91(18 Dec 1971).

A theorem is presented which gives the necessary and sufficient conditions for the validity of the KSFR sum rule and which stresses in particular its close connection to unitarity. The Lehmann–Symanzik–Zimmerman method applied to the proper vertex of the vector current between pion states is used in the proof of the theorem. (L.B.S.)

16341 NEW MODEL FOR THE POMERON AND THE ISR DATA. Ilyin, V. V.; Enkovszkii, L. L.; Kobylinskii, N. A. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 3: No. 2, 75-9(8 Jan 1972).

The slope parameter, total cross sections, and ratio of real to imaginary parts of the amplitudes for elastic $\bar{p}p$ and pp scattering are considered for the case when β trajectories are mirage trajectories bounded from above. Effective β trajectories differing only by their intercepts were previously introduced for the pomeron background and exotic states. The parameters obtained are compared with some recent ISR data. (J.F.P.)

Strong (Baryon No. = 1)

Refer also to abstracts 16194, 16222, 16400, and 16414.

16342 (CEA-N-1502(E)) REGGE ANALYSIS OF THE HYPERCHARGE-EXCHANGE REACTIONS $\pi N \to K\Sigma$, $KN \to \pi\Sigma$, AND $K^-n \to \eta\Sigma^-$. de Brion, Jean-Pierre; Derem, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1971. 49p. Dep. NTIS (U.S. Sales Only).

The reactions $\pi N \to K\Sigma$, $KN \to \pi\Sigma$ and $K^-n \to \eta\Sigma^-$, for which the t-channel is pure hypercharge exchange, are analyzed in the framework of a Regge pole model with corrective cuts. The leading 1^- and 2^+ trajectories are assumed to be degenerate and to extrapolate linearly through the masses squared of the $K^*(890)$ and $K_N(1420)$. The corrective Regge cuts, which are assumed to transform like SU(3) octets as for the leading poles, are given a parametric form and the parameters are fitted. The data analysis extends from 3 GeV/c upwards and is limited to $t < 1.2$ GeV^2. Agreement with the data is obtained only for dissymmetrical positive and negative signature Regge cuts. The difficulties seem to concentrate on the negative signature contributions. (France)

16343 (JINR-E2-6161) INVESTIGATION OF THE HIGH-ENERGY BEHAVIOR OF THE "MESON–NUCLEON" SCATTERING AMPLITUDE IN SCALAR MODEL BY FUNCTIONAL METHOD. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 16p. Dep. NTIS (U. S. Sales Only).

The high energy "meson-nucleon" scattering amplitude is investigated in the scalar model $L_{int} = g\psi^2\phi$ by the functional method. The sum of the infinite class of diagrams in which the "meson" interacts with the "nucleon" turning into a virtual "nucleon-antinucleon" pair can be presented in a modified eikonal form. (auth)

16344 COMPLEX REGGE POLES AND HYPERCHARGE-EXCHANGE REACTIONS. Chylek, Petr (Indiana Univ., Bloomington). Phys. Rev., D; 4: No. 11, 3509-10(1 Dec 1971).

The difficulties of the Regge-pole model in the hypercharge-exchange reactions are pointed out and the presence of the cuts is argued. The pole-cut amplitude is considered in the complex-conjugate-poles approximation. From experimental data for $K^-n \to \Lambda\pi^-$ and $\pi^-p \to \Lambda K^0$ the strong form of exchange degeneracy between K^* and K^{**} trajectories at $t = -0.4$ (GeV/c)^2 is deduced. (auth)

16345 NONANALYTIC BEHAVIOR OF THE Σ TERM IN π–N SCATTERING. Pagels, Heinz (Rockefeller Univ., New York); Pardee, W. J. Phys. Rev., D; 4: No. 11, 3335-7(1 Dec 1971).

The Σ term in the πN scattering amplitude is commonly evaluated at squared nucleon momentum transfer $t = 2\mu^2$, where μ is the pion mass. Because of the nonanalytic nature of perturbations about the chiral SU(2) × SU(2) limit, $\Sigma(2\mu^2)$ differs from $\Sigma(0)$ by a term linear in μ. The difference term is calculated exactly to $O(\mu)$ and $\Sigma(2\mu^2) - \Sigma(0) = (3/8\pi)[(g_A/2F_\pi)^2](\mu/F_\pi) + O(\mu^2 \ln \mu^2)$ is obtained. This represents a 14-MeV correction to the value of $\mu^2 F_\pi \Sigma(2\mu^2)$. (auth)

16346 HELICITY STRUCTURE OF THE P AND P' CONTRIBUTIONS TO TWO-BODY SCATTERING AMPLITUDES. Zarmi, Y. (California Inst. of Tech., Pasadena). Phys. Rev., D; 4: No. 11, 3455-65(1 Dec 1971).

Various tests for the determination of the helicity structure of the P and P' contributions to two-body scattering amplitudes are studied. Most types of existing data are shown to be incapable of distinguishing between s- and t-channel helicity conservation. Duality tests probably indicate s-channel helicity conservation for the Pomeranchuk contribution, but are inconclusive as far as the P' is concerned. The only direct evidence for s-channel helicity conservation by the Pomeranchuk contribution is the measurement of the R parameter in the π^-p elastic scattering. The conclusion about the P' depends on what is assumed about the Pomeranchuk contribution. (auth)

16347 POLARIZATION AND DIP-BUMP STRUCTURE IN π^-p CHARGE-EXCHANGE SCATTERING. Kogitz, S.; Logan, R. K. (Univ. of Toronto). Phys. Rev., D; 4: No. 11, 3289-92 (1 Dec 1971).

It is shown that the new π^-p charge-exchange polarization and differential cross-section data at large angles can be explained in terms of a simple model which includes a ρ Regge pole plus a background term which one may interpret as either a secondary pole or a cut. It is shown that the rise after the dip is primarily due to the background term and not the spin–flip Regge term recovering from α passing through zero near $t = -0.6$ GeV^2. The effect of this insight on dip systematics is discussed. (auth)

16348 QUARK MODEL AT LOW ENERGIES. Feynman, Richard P. (California Inst. of Tech., Pasadena). pp 224-56 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A summary is given of previous work on the performance of the quark model for giving correct estimates for low-energy matrix elements of currents between various resonant states. Previous calculations are remade uniformly. The hadron spectrum, baryon dynamics, adjustable constants, matrix elements of vector currents, and axial current matrix elements are discussed. (J.F.P.)

16349 PION–NUCLEON SCATTERING: EXPERIMENTS AND PHASE SHIFTS. Steiner, Herbert M. (Univ. of California, Berkeley). pp 420-43 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech. (1971).

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A brief report on the status of pion–nucleon phase shifts is given. The fits to experimental data are considered. (J.F.P.)

16350 OPTIMIZED ANALYTIC DATA ANALYSIS AND APPLICATION TO K^+p SCATTERING. Cutkosky, R. R. E. (Carnegie-Mellon Univ., Pittsburgh). pp 444-66 of Phenomenology in Particle Physics 1971. /Chiu, C. B. (ed.). Pasadena, Calif.; California Inst. of Tech.

From Conference on the phenomenology of particle physics; Pasadena, Calif. (25 Mar 1971).

A new approach to data analysis, the optimized analytic data analysis, is considered. Some preliminary results for the analysis of $K^+ + p$ data are discussed. The most striking effect is that significant contributions from the high partial waves is found. This is consistent with the known fact that K^* production is highly peripheral. (J.F.P.)

16351 ESTIMATION OF THE ASYMPTOTIC PSEUDOSCALAR-MESON–BARYON TOTAL CROSS SECTION FROM THE AMATI–BERTOCCHI–FUBINI–STANGHELLINI–TONIN MULTIPERIPHERAL MODEL. Chan, Chun-fai (Univ. of California, Berkeley). Phys. Rev., D; 4: No. 11, 3466-75(1 Dec 1971).

The high-energy forward scattering of a pseudoscalar meson (μ) and a baryon (B) is discussed on the basis of the Amati–Bertocchi–Fubini–Stanghellini–Tonin multiperipheral model. Assuming that the low-energy μB amplitude is dominated by the baryon pole plus the first elastic resonance, and using the approximate solution to the $\mu\mu$ integral equation proposed by Abarbanel, Chew, Goldberger, and Saunders, an expression is derived for the high-energy limit of σ^{tot}. A numerical estimate based on SU(3) symmetry is given. (auth)

16352 DIPS AND SPIKES IN $d\sigma/dt$ FOR HIGH-ENERGY EXCHANGE REACTIONS. Dar, Arnon (Technion-Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.); 69: No. 1, 1-18(Jan 1972).

A simple interpretation is offered for the origin of dips and

spikes in $d\sigma/dt$ for high-energy meson exchange reactions. Quantitative predictions are in good agreement with experimental measurements. (10 figures, 4 tables) (auth)

16353 REGGE POLE-CUT EFFECTIVE TRAJECTORIES AND THE DUAL ABSORPTIVE MODEL. Vasavada, K. V. (Indiana Univ., Indianapolis. Purdue Univ., Indianapolis). Lett. Nuovo Cim.; 2: No. 26, 1339-45(25 Dec 1971).

Harari's dual absorptive model for two-body hadronic amplitudes is examined. Reciprocals of Γ-functions involving effective trajectories with pole and cut contributions are proposed, which simulate the behavior of Bessel functions in the s-channel and remove the ghosts in the real part of the amplitude in the dual absorptive model. Fits to meson–baryon amplitudes in the two models are compared. (L.B.S.)

16354 ENERGY DEPENDENCE OF THE ELASTIC DIFFRACTION SLOPES. Lasinski, T.; Setti, R. Levi; Schwarzschild, B.; Ukleja, P. (Univ. of Chicago). Nucl. Phys.; B37: No. 1, 1-58(1971).

The diffraction-slope parameter B was redetermined and compiled for $\pi^{\pm}p$, $K^{\pm}p$, pp, and $\bar{p}p$, fitting the forward-elastic data from the literature to $\ln d\sigma/dt = A + Bt + (Ct^2)$. This compilation, together with the total-cross-section data, is fitted to a Regge model with a pomeron of slope $\sim 1/2$ interfering with exchange-degenerate meson trajectories. Thus the observation that the pomeron seems to dominate the exotic channels already at much lower energies than the resonant channels is accounted for. In resonant regions the model provides only a duality-average description. To give a non-resonant account of the observed structure in the exotic channels just above pion-production threshold, cuts were included for the first quasi-two-body thresholds, and a diffraction-threshold factor for the pomeron amplitude. The cuts turn out to give non-resonant Argand circles. At Serpukhov energies, the gradual emergence of the pomeron from the onset of inelasticity provides a possible description of the Regge-anomalous σ_T data. Though data above 70 GeV/c were not fitted, the solution with a pomeron slope of 0.4 $(GeV/c)^{-2}$ extrapolates reasonably well to the new ultra-high-energy CERN-ISR B(pp) data. (auth)

16355 FUPTHER TESTS OF EXCHANGE DEGENERACY AND DUALITY USING THE KN CHARGE EXCHANGE REACTIONS. Cline, D.; Matos, J. (Univ. of Wisconsin, Madison). Nucl. Phys.; B37: No. 1, 161-72(1971).

Analysis of the sums and differences of the KN charge exchange angular distributions from 1 to 12 GeV/c provides strong quantitative evidence that the ρ and the A_2 Regge trajectories are exchange degenerate. The contribution of the effective secondary trajectory or cut responsible for the breaking of duality $d\sigma/dt\,(K^+n \to K^0p) \neq d\sigma/dt\,(K^-p \to \bar{K}^0n)$ for $t \neq 0$) in these reactions is shown to be unimportant above ~3 GeV/c. The SU(3) charge exchange sum rule is shown to be valid down to 1.25 GeV/c, implying a strong connection with the duality principle. This sum rule is used to predict angular distributions for the reaction $\pi^-p \to \eta n$ at 1.6 and 2.3 GeV/c. (auth)

16356 MULTICHANNEL LOOK AT THE AVAILABLE PARTIAL-WAVE ANALYSES OF THE $\bar{K}N$ SYSTEM IN THE REGION 0 TO 1400 MeV/c. Gupta, Madan L.; Arndt, R. A.; Roper, L. David (Virginia Polytechnic Inst. and State Univ., Blacksburg, Va.) Nucl. Phys.; B37: No. 1, 173-202(1971).

The available partial-wave analyses on the $\bar{K}N$ scattering data, the majority of which are single-channel analyses over limited momentum ranges, are studied with a view to facilitate a multichannel partial wave analysis over an extended momentum range (0–1400 MeV/c). The high-energy behavior of the $\bar{K}N$ scattering amplitudes is examined by making energy-dependent multichannel M-matrix fits to the best sets of partial-wave scattering amplitudes over the entire momentum range under consideration. Finally, the same fits are repeated on the low-momentum (0–500 MeV/c) scattering amplitudes, and the parameters obtained can be used as starting points in a multichannel partial-wave analysis on the $\bar{K}N$ scattering data. (auth)

16357 STUDY OF THE INCLUSIVE REACTIONS $K^+p \to K^*(890) + X^+$ AND $K^+p \to K^*(1420) + X^+$ AT 8.2 GeV/c. Chliapnikov, P. (CERN, Geneva); Czyzewski, O.; Goldschmidt-Clermont, Y.; Jacob, M.; Herquet, P. Nucl. Phys.; B37: No. 1, 336-48(1971).

The K*, very strongly produced in K^+p collisions at 8.2 GeV/c, are separated out in an inclusive analysis. The key features of their missing mass and momentum transfer distributions are compared to those already seen in the $K^+p \to K^0$ + anything, inclusive reaction and which are those expected from a simple Regge model. The K* results here reported are also compatible with such a model. An important contribution from pion exchange is required at small four-momentum transfers in contradistinction with what is found for quasi elastic production. (auth)

16358 RESONANCE DOMINANCE OF FORM FACTORS USING SIDEWISE DISPERSION RELATIONS. Nagylaki, T. (Oregon State Univ., Corvallis). Lett. Nuovo Cim.; 2: No. 25, 1282-6(18 Dec 1971).

It is demonstrated that no consistent nontrivial solution exists for the saturation of sidewise dispersion relations for form factors by narrow resonances. The coupling of spin-1/2 baryons to a pseudoscalar meson is dealt with, but generalization can be made to an arbitrary coupling. (L.B.S.)

16359 ISOSPIN BOUNDS ON POLARIZATION IN MESON–BARYON SCATTERING. Korkea-Aho, M.; Toernqvist, N. A. (Univ. of Helsinki). Lett. Nuovo Cim.; 2: No. 25, 1305-8 (18 Dec 1971).

Bounds on the cross sections and polarizations for spin 0–spin $1/2^+$ processes that proceed through two isospin channels are given in terms of triangle inequalities. The bounds are illustrated graphically by plotting the polarizations against each other in a three-dimensional diagram. (L.B.S.)

16360 DIPS IN ONE-PION PRODUCTION PROCESSES FROM A STATISTICAL POINT OF VIEW. Galloway, K. F.; Mann, A.; Weiner, R. M. (Indiana Univ., Bloomington). Lett. Nuovo Cim.; 2: No. 25, 1295-8(18 Dec 1971).

It is pointed out that a statistical model which assumes the existence of pions in the nucleon with an effective mass squared of approximately 0.01 $(GeV)^2$ gives a satisfactory description of t-dependence of the differential cross section $d\sigma/dt$ at small t for the one-pion-exchange processes $\pi^-p \to \rho^0n$ and $\pi^-p \to \pi^-\pi^+n$. (L.B.S.)

16361 HELICITY CONSERVATION AND SCALE INVARIANCE. Chanda, R. (University Coll., Dublin). Lett. Nuovo Cim.; 3: No. 3, 105-7(15 Jan 1972).

A possible connection between s-channel helicity conservation and scale invariance is noted in that both symmetries seem to be broken in the same manner. Pion–nucleon scattering is considered. (J.F.P.)

16362 PIONIZATION. Sugawara, Hirotaka (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1478-84(Nov 1971).

The normalization factor for the one-pion distribution function is calculated. The result shows that the multiplicity cannot increase unless the S-channel helicity conservation is violated in the inelastic process. (auth)

16363 REGGEIZED SHORT-RANGE POTENTIAL USING THE VENEZIANO REPRESENTATION. Imoto, Michiko (Nihon Univ., Chiba, Japan). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1469-77 (Nov 1971).

The short-range potential is Reggeized in the formalism for pion-nucleon scattering, which satisfies the theoretical requirements of analyticity, unitarity, crossing symmetry, correct threshold behavior and correct asymptotic behavior. Then, this Reggeization is performed using the Veneziano amplitude, and this potential has a very simple and applicable form. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 16245 and 16488.

16364 (COO-264-596) CURRENT ALGEBRA IN TWO PARTICLE BASIS AND SINGLE PARTICLE INCLUSIVE PROCESSES. Chang, Lay Nam (Pennsylvania Univ., Philadelphia. Dept. of Physics); Fujikawa, Kazuo (Chicago Univ., Ill. Enrico Fermi Inst.). Nov 1971. Contract AT(11-1)-264. 26p. (EFI-71-71). Dep. NTIS.

Several problems involved in the current algebra sum rules derived by Suzuki and his collaborators are discussed. In particular the ambiguities related to soft current insertion to the external lines are discussed. Alternative prescriptions to get similar sum rules are also discussed. An application of the sum rule to the W-production process is briefly discussed. (auth)

16365 SLOPE OF THE FORWARD PEAK IN pp SCATTERING AND THE REGGE-POLE MODEL. Austin, Donald M.; Rarita, William (Univ. of California, Berkeley). Phys. Rev., D; 4: No. 11, 3507-8(1 Dec 1971).

A recent Regge-pole model based on pp and $\bar{p}p$ cross sections and polarizations is extrapolated to determine the slopes of the pp differential cross section for the energies and momentum transfers just measured at the CERN intersecting storage rings. The slopes thus predicted come close to the published experimental values, and show a strong t dependence. The average Pomeranchuk slope (α'_P) for our several fits was 0.31 $(GeV/c)^{-2}$. (auth)

16366 MESON MULTIPLICITY FOR THE REACTION pp → ppX IN A BREMSSTRAHLUNG MODEL. Fried, H. M. (Brown Univ., Providence); Gaisser, T. K. Phys. Rev., D; 4: No. 11, 3330-5(1 Dec 1971).

The differential meson multiplicity as a function of the six invariant variables that determine the process pp → ppX is derived in a bremsstrahlung model, and contrasted with the corresponding prediction of the multiperipheral model. (auth)

16367 $^1S_0$ PHASE SHIFT FOR NUCLEON–NUCLEON SCATTERING BY THE NAMBU–SALPETER–BETHE EQUATION. III. Murota, Toshiyuki (Hokkaido Univ., Sapporo); Noda, Matu-tarow; Tanaka, Jujio. Progr. Theor. Phys. (Kyoto); 46: No. 5, 1456-68 (Nov 1971).

The Nambu–Salpeter–Bethe equation for the $^1S_0$ state of nucleon-nucleon scattering is solved numerically including the negative-energy intermediate states. Calculation is made for the exchange of pion, isoscalar vector meson (μ_V = 775.0 MeV) and scalar meson (μ_s = 556.0 MeV), respectively. The results show that the contribution from the negative-energy intermediate states does not alter the results from only positive-energy intermediate states for the vector-meson exchange, that it alters them quantitatively but not qualitatively for the scalar-meson exchange and that it alters qualitatively them for the pion exchange in the range of coupling constant $g^2/4\pi \leq 15$. Our results seem to show that the conjecture by Gammel et al., which connects the appearance of a pole in tan δ to Mandelstam's condition, is not valid. (auth)

16368 INCLUSIVE REACTIONS AND URBARYON REARRANGEMENT DIAGRAMS. Kinoshita, Kisei; Noda, Hujio (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1639-41(Nov 1971).

The inclusive reactions pp → cX, where c denotes p, π^+, π^-, K^+, K^-, or $\bar{p}$, are studied on the basis of urbaryon rearrangement diagrams URD combined with Mueller's approach. In particular the features of the production mechanism for particle c are characterized by three types of URD in the scaling limit corresponding to the diffraction mechanism, the fragmentation mechanism, and the pionization-like mechanism. The consequences of factorization within each diagram are discussed. (L.B.S.)

16369 ASYMPTOTIC BEHAVIOR OF TOTAL CROSS SECTIONS AND ADDITIONAL ODD-SIGNATURE MESON TRAJECTORIES. Minami, Shigeo (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1629-30(Nov 1971).

It is pointed out that in the high energy limit, $\sigma_t(\bar{p}\text{-}p)$ may turn out to be smaller than $\sigma_t(p\text{-}p)$ as the effects of the additional odd-signature meson trajectories (the $\tilde{\omega}$ and ρ trajectories). The cases are considered where the $\tilde{\omega}(\bar{p})$ is described by a single Regge pole with the imaginary part and a complex conjugate pair of Regge poles. It is emphasized that the existence of the additional odd-signature meson trajectories not only explains the characteristic features of the differential cross sections for $\bar{p}$-p (p-p) elastic scattering around t = 0.5 $(GeV/c)^2$ but also the asymptotic behavior of total cross sections for $\bar{p}$-p, p-p, $\pi^+(\pi^-)$-p, and $K^+(K^-)$-p scattering. (L.B.S.)

16370 FOUR-MOMENTUM TRANSFER DISTRIBUTION OF THE RECOIL PROTON FOR INELASTIC pp COLLISIONS. Muraki, Y.; Nakagawa, M. (Nagoya Univ., Japan). Lett. Nuovo Cim.; 3: No. 3, 121-4(15 Jan 1972).

An attempt is made to derive the inelastic p + p differential cross section for the four-momentum transfer squared of the recoil proton with the kinematical transform of the differential cross section for the transverse momentum of the recoil proton. Results are given for incident particle energies of 30, 200, and 1000 GeV and the values 0.5 and 2.0 GeV/c for the mean transverse momentum. (J.F.P.)

16371 BINDING ENERGY OF A Λ-PARTICLE IN NUCLEAR MATTER. Grypeos, M. E. (Univ. of Thessaloniki, Greece. Democritus Nuclear Research Center, Athens). Lett. Nuovo Cim.; 3: No. 3, 129-31(15 Jan 1972).

Results obtained by applying a variation approach, in which the binding energy of a lambda particle in infinite nuclear matter is calculated with a trial Jastrow-type many-body wave function, are presented. This is determined by means of functional variation. The new result obtained is a nonlinear integro-differential equation for the correlation function. (J.F.P.)

16372 SPECULATION ON SOME PROBLEMS CONCERNING LARGE MOMENTUM-TRANSFER COLLISIONS. Muraki, Y.; Nakagawa, M. (Nagoya Univ., Japan). Lett. Nuovo Cim.; 3: No. 3, 125-8(15 Jan 1972).

An explanation other than the statistical model is given for high-energy transfer collisions at high energies. Differential cross sections are discussed for elastic p + p, π + p, e + p, μ + p interactions and for inelastic ν + p interactions. It is predicted that in elastic neutrino–hadron scattering the shrinkage of the differential cross section will appear. (J.F.P.)

16373 ANGULAR BEHAVIOUR OF THE K/π RATIO AT HIGH ENERGY IN THE MULTI-REGGE MODEL. Boldrighini, C., (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Lusanna, L. Lett. Nuovo Cim.; 3: No. 2, 58-62(8 Jan 1972).

The predictions for the K/π production cross section ratio for p + p interactions at high energies in the multiperipheral model are discussed. (J.F.P.)

16374 LIGHT-CONE LIMITS, REGGE LIMITS, AND MASSIVE LEPTON-PAIR PRODUCTION. Baker, H. C.; Lu, E. Y. C.; Shrauner, E. (Washington Univ., St. Louis). Phys. Lett.; 38B: No. 2, 110-14(24 Jan 1972).

The connection between the deep Regge limit and the deep light cone limit for electroproduction and massive lepton–pair production is investigated. Triple-Regge and annihilation contributions to massive muon–pair production are assessed. (auth)

16375 PHENOMENOLOGICAL DUALITY FOR POMERON–PROTON SCATTERING. Frampton, P. H.; Ruuskanen, P. V. (CERN, Geneva). Phys. Lett.; 38B: No. 2, 78-80(24 Jan 1972).

Data on p + p → p + N* for 5 to 30 GeV/c at small t is extrapolated to s → ∞; the Pomeron-proton forward amplitude is found to be resonance dominated, the resonances being dual to a trajectory with intercept $\alpha(0) \lesssim \frac{1}{2}$. This suggests that the Pomeron-Pomeron-Reggeon coupling is non-zero. (auth)

16376 SCALING AT VERY HIGH ENERGY AND AN EMULSION EXPERIMENT AT THE ISR. Ranft, J.; Ranft, Gisela (Karl-Marx-Univ., Leipzig). Phys. Lett.; 38B: No. 2, 115-16 (24 Jan 1972).

With reference to a recent paper of the Bombay–CERN–Cracow collaboration, it is shown that the ISR emulsion experiment does not disprove scaling. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 16386–16388.

16377 MANIFESTLY CONFORMAL COVARIANT OPERATOR-PRODUCT EXPANSION. Ferrara, S. (CNEN, Frascati, Italy); Grillo, A. F.; Gatto, R. Lett. Nuovo Cim.; 2: No. 26, 1363-9(25 Dec 1971).

A method that takes advantage of the isomorphism between the conformal algebra and the orthogonal algebra and makes use of a six-dimensional pseudo-Euclidean coordinate space is further developed to derive a manifestly conformal covariant operator-product expansion. (L.B.S.)

16378 GENERALIZED DESTRUCTION OPERATORS AND A NEW METHOD IN GROUP THEORY. Aharonov, Y. (Univ. of South Carolina, Columbia); Huang, H. W.; Knight, J. M.; Lerner, E. C. Lett. Nuovo Cim.; 2: No. 25, 1317-20(18 Dec 1971).

The property of coherent states of harmonic oscillators as eigenstates of the destruction operator under influence of appropriate driving forces is generalized for operators having a non-degenerate set of eigenstates spanning a Hilbert space. A set of Hermitian generators and operators which satisfy the condition for a Hamiltonian to generate transformations of the set of eigenstates into itself and which will generate representations of successively higher rank Lie algebras is examined. (L.B.S.)

16379 SYMMETRIC ALGEBRA FOR SU(3) x SU(3) REPRESENTATIONS AND BROKEN CHIRAL AND SCALE INVARIANCE. Chakrabarti, A.; Darzens, C. (Ecole Polytechnique, Paris). Ann. Phys. (N. Y.); 69: No. 1, 193-217(Jan 1972).

In the first part of the corresponding symmetric algebras for the representations $(6,\bar{6}) \oplus (\bar{6},6)$ and (8,8) are studied, following the ideas of Michel and Radicati. For each case, for this algebra, the idempotents and nilpotents of interest are constructed. It is shown in particular, that for each case, only the SU(3) scalar (denoted by w_0) is the only idempotent which does not contain the (27) representation of SU(3). In the second part some consequences of generalizing the well-known $(3,\bar{3}) \oplus (\bar{3},3)$ symmetry-breaking Hamiltonian by including a w_0 term from either $(6,\bar{6}) \oplus (\bar{6},6)$ or (8,8) are

studied. This is done in the context of broken dilatation symmetry. The constraints imposed on the dimensions of the two different chiral symmetry-breaking terms are studied by exploiting certain basic positivity properties, without introducing meson pole dominance or related types of approximations. (auth)

16380 GROUP THEORY AND ITS APPLICATIONS. Loebl, Ernest M. (ed.). New York; Academic Press Inc. (1968). 717p. $19.50.

The topics covered are the algebras of Lie groups and their representations, induced and subdued representations, generalization of Euler's angles, projective representation of the Poincare group in a quaternionic Hilbert space, group theory in atomic spectroscopy, group lattices and homomorphisms, group theory in solid state physics, group theory of harmonic oscillators and nuclear structure. Also broken symmetry, broken SU(3) as a particle symmetry, and de Sitter space and positive energy are treated. (J.F.P.)

16381 GROUP THEORY AND ITS APPLICATIONS. VOLUME II. Loebl, Ernest M. (ed.). New York; Academic Press Inc. (1971). 320p. $18.50.

Topics discussed include representations and tensor operators of the unitary groups, symmetry and degeneracy, dynamical groups in atomic and molecular physics, symmetry adaptation of physical states by means of computers, and the Galilei group and Galilean invariance. (J.F.P.)

Applications (Electromagnetic and Weak)

Refer also to abstracts 16201 and 16563.

Applications (Strong)

Refer also to abstract 16318.

16382 CONSEQUENCES OF INTERNAL SYMMETRIES FOR INCLUSIVE PROCESSES. Cahn, Robert N. (Univ. of California, Berkeley); Einhorn, Martin B. Phys. Rev., D; 4: No. 11, 3337-44(1 Dec 1971).

Consequences of C invariance, isospin invariance, and unitary symmetry for limiting distributions are derived. The same symmetries are used to isolate the nonscaling contributions. Many of the predictions are susceptible to direct experimental test. The relations based on unitary symmetry are expected to be violated and thus furnish extensive challenges to symmetry-breaking models. The relations based on isospin and C invariance are expected to be exact (asymptotically) at high energies. (auth)

16383 POSSIBILITY OF PARITY NONCONSERVING STRONG INTERACTIONS. Yamaguchi, Yoshio (Tokyo Univ.). J. Phys. Soc. Jap.; 32: No. 2, 316-19(Feb 1972).

A possibility of parity-violating strong interactions is discussed. A particular emphasis is made in order to understand the unique situation: the parity conservation could be satisfied with very good accuracies for low energy phenomena in nuclear and particle physics even when strong interactions are P-violating. (auth)

Field Theories

General

16384 PROPAGATION OF SIGNALS IN THE FIELD THEORETICAL BLUDMAN-RUDERMAN MODEL. Velo, G. (Univ., Bologna). Lett. Nuovo Cim.; 3: No. 2, 80-2(8 Jan 1972).

The presence of noncausality is confirmed in the model for a class of situations larger than those previously considered for which a Lorentz invariant field theoretical model was studied. The analysis of the noncausal propagation properties of the model is performed using a Lagrangian. (J.F.P.)

Quantum Field Theory

Refer also to abstracts 16233, 16243, 16303, and 16328.

16385 (COO-1573-92) ABSENCE OF SECOND-ORDER CORRECTION TO THE TRIANGLE ANOMALY IN QUANTUM ELECTRODYNAMICS. Young, B.-L. (Ames Lab., Iowa); Wong, T. F. (Brookhaven National Lab., Upton, N. Y.); Gounaris, G. (Democritus Nuclear Research Center, Athens (Greece)); Brown, R. W. (Case Western Reserve Univ., Cleveland, Ohio). Mar 1971. 19p. (BNL-15753). Dep. NTIS.

The investigation of possible ambiguities involved in calculating the second-order correction to the axial-vector anomaly is reported. The testing ground is finite-mass quantum electrodynamics where the anomaly is defined using Pauli-Villars regularization. The result supports Adler's previous conclusion that there exist no such corrections. Furthermore, the mass renormalization is explicitly shown to be consistent in this order. (auth)

16386 (NYO-3829-80) CONFORMAL SYMMETRY AND REVERBERATIONS. Hortacsu, M.; Seiler, R.; Schroer, B. (Pittsburgh Univ., Pa. Dept. of Physics). Sep 1971. Contract AT(30-1)-3829. 51p. Dep. NTIS.

It is shown that the operator conformal invariance breaks down for zero-mass fields unless they are free fields in even space-time dimension. This phenomenon is linked to the occurrence of "reverberations." One is led to the concept of weak conformal symmetry. In theories with anomalous dimensions one has reverberations and can only maintain weak conformal invariance. (auth)

16387 (UR-875-368) TRANSFORMATION PROPERTIES UNDER BROKEN SYMMETRY. Bace, M. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 29 Dec 1971. Contract AT(30-1)-875. 28p. Dep. NTIS.

A general condition is derived which allows a local field (in an arbitrary field theory) to belong simultaneously to a fixed representation of the Lorentz group and a given representation of a broken symmetry group. Specializing to local currents one obtains the condition of Gross and Jackiw for a complete current algebra, the condition of Bég et al. for the dimension of a current component to be independent of its Lorentz index, and the condition necessary for covariant derivatives in broken chiral theories to be covariant. Also, one is able to understand observations of Kimel on the failure of complete current algebra in gauge field models with mass-breaking terms, those by Takahashi and others on the impossibility of assigning a dimension to Duffin-Kemmer scalar and Klein-Gordon vector fields, and some other specific results. The above condition allows a critical examination of operator product expansions. The point of the research is in its generality; it makes possible a unified view of a large number of specific results and observations. (auth)

16388 AUTOMORPHISM GROUPS OF C*-ALGEBRAS, FELL BUNDLES, W*-BIGEBRAS, AND THE DESCRIPTION OF INTERNAL SYMMETRIES IN ALGEBRAIC QUANTUM THEORY. Mayer, M. E. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France. Univ. of California, Irvine). Acta Phys. Austr.; Suppl. 8, 177-226(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

Lectures on some mathematical aspects of the algebraic approach to quantum field theory are given. The purposes are to provide a simple introduction to the mathematical techniques used to describe automorphisms of the algebras associated with infinite quantum systems, and to propose a new way of regarding internal symmetries by means of W* bigebras. (J.F.P.)

16389 ULTRALOCAL QUANTUM FIELD THEORY. Klauder, J. R. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Acta Phys. Austr.; Suppl. 8, 227-76(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

A special class of model field theories, differing from relativistic theories by the absence of the spatial gradient in the Hamiltonian, is discussed. Simple operator solutions are constructed which circumvent the infinite mass renormalization, infinite coupling constant renormalization and infinite field strength renormalization inherent in a perturbation approach. A number of properties of these solutions are analyzed including the spectrum of the Hamiltonian. Compared to free field theories, the ultralocal models discussed herein may, conceivably, provide an alternate starting point to attack covariant field theories. (auth)

16390 NULL PLANE FIELD THEORY. Rohrlich, F. Syracuse Univ., N. Y.). Acta Phys. Austr.; Suppl. 8, 277-322(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

Lectures are given on a coherent and logically consistent introduction to null plane field theory starting from first principles. The topics covered are invariant null plane coordination, the classical initial value problem on a null plane, null plane classical field theory, scalar null plane quantum field theory, and null plane quantum electrodynamics. (J.F.P.)

16391 SOME EXTERNAL FIELD PROBLEMS IN QUANTUM ELECTRODYNAMICS. Erber, T. (Illinois Inst. of Tech., Chicago). Acta Phys. Austr.; Suppl. 8, 323-57(1971).

From tenth international conference on concepts in hadron physics; Schladming, Austria (1 Mar 1971).

This review of external field problems in quantum electrodynamics covers megagauss bremsstrahlung experiments and theory, radiation reaction, and vacuum polarization Cherenkov radiation. (J.F.P.)

16392 QUANTIZATION IN A CURVED SPACE–TIME. Moreno, Carlos (Paris Univ.). Compt. Rend., Ser. A; 273: No. 18, 830-3(3 Nov 1971). (In French).

A theorem relative to the Cauchy problem for the Klein–Gordon equation of a curved space–time is described. Using this theorem, the concept of a field associated with a solution of the equation can be introduced in a manner similar to that adopted by Segal. This field can be identified with an operator which generates a group with one parameter. The field commutator associated with the two solutions is calculated. These ideas are the bases of a rigorous interpretation of the commutation relations satisfied by a real scalar quantum field in a curved space time postulated by Lichnerowicz. (France)

16393 CANONICAL TRANSFORMATION BY COMPUTER (FOLDY–WOUTHUYSEN TRANSFORMATION). Rosen, Bernard (Stevens Inst. of Tech., Hoboken, N. J.). J. Comput. Phys.; 8: No. 3, 369-81(Dec 1971).

A method for calculating canonical transformations by computer is illustrated by a specific example. Techniques, with wider application, for handling Dirac gamma matrix algebra, Heisenberg commutation relations and most of vector analysis were developed. The programs used the IBM FORMAC routines; the techniques developed indicate applications of FORMAC to noncommutative algebras by means of list processing within the syntax of those routines. The particular canonical transformation considered was that of Foldy and Wouthuysen on the Dirac Hamiltonian with electromagnetic potentials included. The calculations were carried out to the point at which all the so-called even operators up to the fourth order in the reciprocal of the mass had been generated (auth)

16394 HOLOMORPHIC DOMAIN OF THE FOUR-POINT FUNCTION. Bruening, E. (Univ., Wuerzburg, Ger.). Commun. Math. Phys.; 23: No. 3, 231-54(1971). (In German).

A new method of constructing analytic continuations of matrix elements of field operators is presented for the example of the fourpoint-functions whose boundary values generate a double commutator. Writing the Wightman-functions as matrix elements of the translation operator an integral representation of these functions over absolutely integrable complex-valued measures which depend analytically on the variables of the Wightman-functions is obtained. By controlling the growth-properties of the analytic continuation of these measures an integral representation of the analytic continuation of these four Wightman-functions into an L^+-invariant domain of holomorphy which connects the original four tubes is found. (auth)

16395 HARISH–CHANDRA CONDITION FOR FIRST-ORDER RELATIVISTICALLY-INVARIANT FREE FIELD EQUATIONS. Glass, A. S. (Princeton Univ., N. J.). Commun. Math. Phys.; 23: No. 3, 176-84(1971).

It has hitherto been accepted that the degree of the Harish–Chandra condition applying to single-mass equations of arbitrary spin is determined by the maximum spin appearing in the representation of SL(2,C) which acts on the field. A fallacy in the published arguments is demonstrated which leads to the above conclusion, and gives the correct conclusion which can be deduced from the hypotheses. A counter-example of an irreducible, single-mass, spin $\frac{3}{2}$ equation which does not satisfy the accepted theory is provided. (auth)

16396 CHIRAL SYMMETRIC INTERACTION OF SPIN-1 FIELDS. Abe, M. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 2: No. 26, 1349-52(25 Dec 1971).

The necessity of the Yang–Mills properties in the construction of chiral invariant Lagrangians for spin-1 fields is studied. It is shown that the Yang–Mills properties and the chiral symmetry can be obtained by the requirement of parity conservation and dimensionlessness of the coupling constants. (L.B.S.)

16397 GENERALIZED NEUTRAL SCALAR FIELDS. Cordesse, A. (College de France, Paris). Lett. Nuovo Cim.; 2: No. 26, 1376-8(25 Dec 1971).

It is proved that a linear mapping $f \rightarrow A(f) = \int d^4x A(x)f(x)$ from Swartz space onto a set of linear operators defined on a Hilbert space exists, which satisfies Wightmann's axioms. It is conjectured that the A(f) may be consistent in the quantum description of some interacting neutral scalar fields. (L.B.S.)

16398 REMARKS ON CHIRAL THEORIES. Patani, A. A.; Shafi, Q. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 3: No. 2, 66-70(8 Jan 1972).

A discussion is given of the problems encountered if the Feynman rules are used for constructing amplitudes in the nonpolynomial approach satisfying the Adler consistency condition. (J.F.P.)

16399 GOTO–IMAMURA–PRADHAN–SCHWINGER TERM IN QUANTUM ELECTRODYNAMICS. Ghose, P.; Das, A. (Visva-Bharati Univ. West Bengal, India). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1623-4(Nov 1971).

The existence of the Goto–Imamura–Pradhan–Schwinger term in quantum electrodynamics and its pathological effect on the change of gauge is considered. It is shown that if the term does exist, there necessarily exists also a killing mechanism which cures the pathology; therefore it need not be eliminated in order to make the quantum electrodynamics self-consistent. (L.B.S.)

16400 FINITE FIELD THEORY IN SOLVABLE MODELS. Kikuchi, Kozo; Yamamoto, Kunio (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1631-2(Nov 1971).

It is shown that, by direct calculation in solvable model, the new finite local theory which requires no additional field gives the same results as those of the present renormalization theory, except for finiteness of renormalization constants. The case of the neutral scalar meson interacting with a fixed nucleon is discussed. (L.B.S.)

Gravitation and General Relativity

Refer also to abstract 15948.

16401 POSSIBILITY OF THE CREATION OF PARTICLES BY A CLASSICAL GRAVITATIONAL FIELD. Zeldovic, Ya. B.; Pitaevskii, L. P. (Inst. of Applied Mathematics, Moscow. Inst. of Physical Problems, Moscow). Commun. Math. Phys.; 23: No. 3, 185-8(1971).

It is pointed out that a previous inequality, while valid for the part of the energy density corresponding to particles already in existence, is in general violated by the part of the energy density corresponding to the polarization which the classical gravitation field causes in the quantized particle vacuum. The creation of electron–positron pairs by a weak gravitational field is discussed in a linear approximation. (J.F.P.)

16402 ACCELERATION OF A SPINNING BODY IN A GRAVITATIONAL FIELD. Barker, B. M. (Louisiana State Univ., Baton Rouge). Lett. Nuovo Cim.; 3: No. 3, 111-13 (15 Jan 1972).

The source of the disagreement in previous work, in which a calculation is given of the differential acceleration between a spinning body and its nonrotating housing using previous equations of motion, is found. This question has been discussed in the context of providing a new test of general relativity. (J.F.P.)

16403 ACCELERATION OF A SPINNING BODY IN A GRAVITATIONAL FIELD. Occhionero, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Lett. Nuovo Cim.; 3: No. 3, 114(15 Jan 1972).

A previously proposed test of general relativity, which was criticized in that it was claimed that the proposed experiment actually gives a null result, is discussed. This null result is said to be true only in the Einsteinian formulation of the theory. The result is null only for $\gamma = 1$, where γ is the coefficient of the Robertson line element. (J.F.P.)

16404 QUANTUM THEORY OF GRAVITATION VS. CLASSICAL THEORY: FOURTH-ORDER POTENTIAL. Iwasaki, Yoichi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1587-1609(Nov 1971).

The perihelion-motion of Mercury depends on the fourth-order potential in quantum field theory; it is a "Lamb shift." In spite of the unrenormalizability of the theory, a finite and physically meaningful quantity, a fourth-order potential, was extracted from fourth-order graphs. Renormalization of the Newtonian potential in the fourth-order perturbation is also discussed briefly. The Hamiltonian obtained is the same as the classical one and so it cannot explain the Dicke–Goldenberg experiment. Fourth-order potential was calculated also in Q.E.D. (auth)

16405 QUANTUM THEORY OF GRAVITY AND THE PERIHELION MOTION OF THE MERCURY. Hiida, Kichiro; Kikugawa, Masayoshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1610-22(Nov 1971).

In the quantum theory of gravity the potential between two celestial bodies is calculated up to order $(v/c)^2$ by treating the celestial bodies as assemblies of nucleons. It is necessary to calculate three-body potentials in order to get the potential proportional to G^2, G being the gravitational constant. A method is discussed for determining the retarded potential uniquely. The potential obtained coincides with the classical one given by Einstein, Infeld and Hoffman. The perihelion motion of the Mercury is also discussed. (auth)

16406 BOUND STATES FOR SPIN-$^1/_2$ PARTICLES IN GENERAL RELATIVITY. Oliveira, C. G.; Arbex, N.; Santoro, A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). An. Acad. Brasil. Cienc.; 43: No. 1, 45-9(Mar 1971).

The problem of bound states for a spin-$^1/_2$ particle interacting with gravitational and electromagnetic fields is discussed. The solutions for the behavior of bound states are free of inconsistencies both at large and small values of the distance from the gravitating mass. (J.F.P.)

Scattering Theory

Refer also to abstracts 16398, 16576, and 16582.

16407 (COO-1573-101) COMPARISON OF APPROXIMATE METHODS FOR MULTIPLE SCATTERING IN HIGH ENERGY COLLISIONS. Tobocman, W.; Pauli, M. (Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics). [1965]. 54p. Dep. NTIS.

The efficacy of several approximate methods for dealing with multiple scattering processes is compared by applying these methods to a simple, soluble model. The model consists of the scattering of a particle by a pair of like particles with motion of all particles constrained to one dimension. Two cases are considered: the target particles have a fixed separation, and the target particles are in a deuteron-like bound state with each other. The interaction of the incident particle with each target particle is the same and is chosen to be a zero range potential. The potential binding the two target particles in case b is equal to this same zero range interaction. The methods compared are the Born approximation for the T-matrix, the impulse approximation for the T-matrix, the WKB approximation, the Glauber approximation, second order multiple scattering theory for the T-matrix, Born approximation for the K-matrix, impulse approximation for the K-matrix, and second order multiple scattering theory for the K-matrix. For the fixed separation case the K-matrix formalisms work much better than the T-matrix formalisms including Glauber theory. Second order multiple scattering theory is superior to Glauber theory for fixed separation. For case b the aforementioned approximate methods are used in conjunction with the adiabatic approximation. Comparison of the calculated transmission probabilities with the exact transmission probability shows the Glauber theory doing much better than any of the other approximate methods. The success of the Glauber theory results from its suppression of a second order term in the multiple scattering expansion which is inadequately damped by the adiabatic approximation. (auth)

16408 DYNAMICALLY BASED COUPLING SCHEME FOR THE POMERANCHUKON. Carlitz, R. (CERN, Geneva. Inst. for Advanced Study, Princeton, N. J.); Green, M. B.; Zee, A. Phys. Rev., D; 4: No. 11, 3439-55(1 Dec 1971).

A coupling scheme for the Pomeranchukon is presented which relates its couplings to those of the f and f' trajectories. In this scheme the Pomeranchukon couplings factorize and transform as a combination of SU(3) singlet and octet in a prescribed ratio. This enables the observed deviation of the ratios of SU(3)-related total cross sections from their symmetry values and, qualitatively, the difference between πp and Kp diffraction slopes to be explained. A certain "universality principle" concerning the relative importance of Pomeranchukon exchange to f-trajectory exchange emerges in this scheme. This is tested with and supported by the available data on πp, pp, γp, and Kp total cross sections. The scheme accommodates quite naturally the observation of s-channel helicity conservation at high energies in πN scattering and ρ photoproduction. On the other hand, it does not predict s-channel helicity conservation in $\pi N \to A_1 N$. Indeed, the possibility that the observation of t-channel helicity conservation in this process may be understood on kinematical grounds is discussed. It is stressed that the coupling scheme is compatible with a large class of dynamical models which differ in the descriptions of the detailed nature of the Pomeranchukon. Thus, this successful confrontation with the available data must be credited to the indispensably essential assumptions that are shared by these different dynamical models. (auth)

16409 ANALYTIC CONTINUATION OF SCATTERING AMPLITUDES AND PADE APPROXIMANTS. Fleischer, J. (Univ., Karlsruhe, Ger.). Nucl. Phys.; B37: No. 1, 59-76 (1971).

A representation of the scattering amplitude in the form of a Taylor series with larger domain of convergence than the Lehmann ellipse–Mandelstam analyticity in the physical plane assumed is derived. The coefficients of this Taylor series are Legendre series evaluated in the physical region if the amplitude is analytically continued into the region of the double spectral function—the analytic continuation on a cut being understood to be done on either side. In order to improve the rate of convergence of the Legendre series, Padé approximants for Legendre series are introduced. These Padé approximants make possible the crossing of scattering amplitudes as well, which has been checked numerically by crossing the box graph in a ϕ^3 theory from the s-channel to the t-channel, starting from its s-channel partial wave expansion. (auth)

16410 REGGEON–REGGEON TOTAL CROSS SECTIONS. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 3: No. 3, 132-4(15 Jan 1972).

The two-particle inclusive distribution near the boundary of phase space is considered, and it is shown that measurements in this region allow one to obtain information concerning the reggeon–reggeon total cross section. (J.F.P.)

16411 GENERALIZED O(1,2) EXPANSIONS OF MULTIPARTICLE AMPLITUDES. Cronstroem, C.; Klink, W. H. (Inst. for Advanced Study, Princeton, N. J.). Ann. Phys. (N. Y.); 69: No. 1, 218-78(Jan 1972).

The formalism for making generalized O(1,2) expansions of multiparticle amplitudes involving particles with arbitrary (nonzero) mass and spin was developed. It is found that such expansions can be made for very general classes of amplitudes; in addition to the requirement of the existence of certain kinematic zeroes, essentially only power boundedness in the expansion variable is required. The physical meaning of the various spin and kinematic variables that occur in the expansion is analyzed in detail. A comparison between the O(1,2) and usual Regge expansions for two-particle amplitudes is made and a fundamental difference between these two types of expansions is pointed out. (auth)

16412 REPRESENTATION OF THE SECOND VIRIAL COEFFICIENT BY THE REGGE POLE. Mishima, Nobuhiko (Tokyo Gakugei Univ.); Suzuki, Akira; Yamazaki, Miwae. Progr. Theor. Phys. (Kyoto); 46: No. 5, 1360-75(Nov 1971).

In previous work an attempt was made to represent the second virial coefficient by parameters of Regge poles. A consistent treatment of this problem is given here again. The main improvements are as follows: First, a modified form of the Beth–Uhlenbeck formula is given, where the effect of the zero energy resonances is correctly treated. Second, the cut in the complex l-plane for the function ln S(l,k) is chosen so as to be consistent with requirement of analyticity and the Levinson theorem. Third, a formula for low-temperature gases is given in a simpler and more convenient form than the previous one. Thus a satisfactory theory is attained in which bound states and resonances including the zero energy ones are equally treated. Further, a method leading to the corrected Beth–Uhlenbeck formula is given in the Appendix and it shows also a general method, from which a cluster integral can be represented in terms of the Jost function, and so, which is useful in application to other problems. (auth)

16413 CONSTRUCTION OF THE SCATTERING AMPLITUDE FROM THE DIFFERENTIAL CROSS SECTION AND THE NEARBY SINGULARITY IN THE COS θ PLANE. Bowcock, J. E.; Lutterodt, C. (Univ. of Birmingham, Eng.). Lett. Nuovo Cim.; 2: No. 25, 1314-16(18 Dec 1971).

A method is devised for constructing a unique scattering amplitude for spinless particles from the differential cross section and the known discontinuity across the nearby cut in the complex cos θ plane. An unusual feature of the construction is that unitarity is not used in a detailed way to give relations between the real and imaginary parts of partial waves. (L.B.S.)

16414 POSSIBLE RELATION BETWEEN THE ABSORPTIVE AND COMPLEX-REGGE-POLE MODELS. Desai, Bipin R. (Univ. of Washington, Seattle. Univ. of California, Riverside). Phys. Rev., D; 4: No. 11, 3321-4(1 Dec 1971).

It is shown that if the absorptive model is assumed for the imaginary part of the amplitude, then the total amplitude can be expressed in terms of complex Regge poles with the phase of the residues determined in terms of R_0, the radius. The imaginary part of α can also be calculated. The results are consistent with πN charge-exchange data and correctly predict the polarization to be positive for low t with a zero at $t \simeq -0.65$ $(BeV/c)^2$. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

16415 LIGHT SCATTERING FROM DENSITY VARIATIONS EXCITED IN ^{4}He BY A THERMAL TRANSDUCER. Petrac, Dusan; Woolf, Michael A. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 28: No. 5, 283-6(31 Jan 1972).

Light scattering from the density variations in the first- and second-sound modes generated simultaneously by a thermal transducer in superfluid ^{4}He was observed. Measurements of the temperature dependence of the density variations in both sound waves agree with the theoretical treatment by Lifshitz of the density-temperature coupling. (auth)

16416 ATTENUATION AND VELOCITY OF SOUND IN SUPERFLUID HELIUM. Maris, Humphrey J. (Brown Univ., Providence). Phys. Rev. Lett.; 28: No. 5, 277-80(31 Jan 1972).

The attenuation and velocity of sound in liquid ^{4}He are calculated, using the Landau–Khalatnikov kinetic equations and the phonon Boltzmann equation. A detailed comparison between theory and experiment is made at 0.35°K and good agreement is obtained over a wide range of frequencies. (auth)

16417 MOTION OF A SUPERFLUID LIQUID IN A NARROW BORE AND AN ANALOG OF THE JOSEPHSON EFFECT. Lukin, V. P.; Tulub, A. V. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1986-95(Nov 1971). (In Russian).

The equations of motion of superfluid helium are considered in the hydrodynamic approximation of the basis of the phenomenological Ginzburg–Pitaevskii theory. An exact solution of the one-dimensional problem in the stationary case is obtained. An investigation of the nonstationary case confirms the general Landau concept of the nature of nonstationary liquid flow. The expressions derived are employed for describing the analog of the Josephson effect in superfluid helium. (auth)

16418 PRESSURE DEPENDANCE OF THE VORTEX CORE PARAMETER IN He II. Glaberson, W. I. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Lett.; 38A: No. 3, 183-4 (31 Jan 1972).

Using a precision time-of-flight technique, the pressure dependence of the vortex core parameter in He II was determined. The results are in reasonable agreement with the predictions of the core model of Glaberson, Strayer, and Donnelly. (auth)

16419 SCINTILLATIONS IN LIQUID HELIUM. Dunscombe, P. B. (Univ. of Birmingham, Eng.). pp 37-42 of Liquid Scintillation Counting. Vol. 1. /Dyer, A. (ed.). London; Heyden and Son Ltd. (1971).

From Symposium on liquid scintillation counting; Salford, England (21 Sep 1970).

The scintillation phenomenon from passage of a charged particle through liquid helium is discussed in terms of current theories of superfluid He primarily for (a) the temperature dependence of the scintillations and (b) the particle producing the scintillations. It is concluded that there is strong evidence for a relation between the temperature dependence of the scintillation intensity and the production of vortices, although the precise mechanism is still open to speculation. A proposal to establish this relationship is briefly presented. 13 references. (L.M.T.)

Superconductivity

Refer also to abstract 15724.

16420 ELECTROMAGNETIC GENERATION OF TRANSVERSE ACOUSTIC WAVES IN THE GIGAHERTZ RANGE USING INDIUM FILMS. Goldstein, Y.; Zemel, A. (Hebrew Univ., Jerusalem). Phys. Rev. Lett.; 28: No. 3, 147-50(17 Jan 1972).

Transverse acoustic waves were generated electromagnetically at 9 GHz using In films with a conversion efficiency α to 5×10^{-5}. A good agreement between theory and experiment was found, and values of 620 Å for the superconducting penetration depth λ at 0.4T and $5 \times 10^{10}\ \Omega^{-1}\ cm^{-2}$ for the ratio of the conductivity to the mean free path for In were obtained. From the temperature dependence of α below the superconducting transition temperature, it is concluded that pair scattering at the surface does not conserve momentum. (auth)

16421 HOLSTEIN PROCESS IN SUPERCONDUCTORS: A NEW SUM RULE. Braendli, G. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2391. Phys. Rev. Lett.; 28: No. 3, 159-61(17 Jan 1972).

Absolute measurements in the far infrared on superconducting Pb and Pb–In alloys show an enhanced surface resistance at the phonon frequencies, mainly due to the Holstein process. These results fit a new sum rule for the surface resistance and reveal an inherent quantitative connection between the Holstein process and superconductivity. (auth)

16422 RIEDEL SINGULARITY IN Sn–Sn-OXIDE–Sn JOSEPHSON TUNNEL JUNCTIONS. Buckner, S. A.; Finnegan, T. F.; Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 28: No. 3, 150-4(17 Jan 1972).

An experimental study has been made of the Riedel singularity in Sn/Sn oxide/Sn Josephson tunnel junctions. The data indicate that gap anisotropy rather than quasi-particle damping is the dominant factor in rounding off the observed singularity. However, it appears feasible to use the singularity as a probe of quasi-particle damping effects. (auth)

16423 EXPERIMENTAL REALIZATION OF HIGHLY REGULAR MOTION OF THE LANDAU DOMAIN STRUCTURE. Farrell, David E. (Case Western Reserve Univ., Cleveland). Phys. Rev. Lett.; 28: No. 3, 154-6(17 Jan 1972).

A new experimental configuration was discovered in which motion of the superconducting domain structure can be realized under ideal conditions. The measured spatial periodicity of the moving structure in tin corresponds closely to the predictions of the Landau model. (auth)

16424 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF Nb–44 PERCENT Ti WIRE. Neal, D. F.; Barber, A. C.; Woolcock, A.; Gidley, J. A. F. (Imperial Metal Industries Ltd., Birmingham, Eng.). Acta Met.; 19: No. 2, 143-9(Feb 1971).

In order to gain a better understanding of flux pinning in a typical commercial Type-II superconductor, a detailed structural examination of the alloy Nb–44% Ti was carried out. Copper-clad, superconducting wires were produced that contained different amounts of cold work and that had been subjected to a range of terminal heat treatments. The maximum Lorentz force ($Jc \wedge H$) associated with these wires was correlated with transverse and longitudinal structures as revealed by electron microscopy. (auth)

16425 SUPERCONDUCTING COLLOIDS WITH MULTIPLE TRANSITION TEMPERATURES. Silvert, William; Singh, Amrendra (Univ. of Kansas, Lawrence). Phys. Rev. Lett.; 28: No. 4, 222-4(24 Jan 1972).

Calculations of the transition temperatures of superconducting colloids are reported. It is found that if the colloidal particles are of less than a certain critical size, they do not affect the transition temperature of the matrix (which may be positive or zero). Some colloidal systems exhibit multiple transition temperatures, going from the normal to the superconducting state and then back to the normal state as the temperature is progressively lowered. (auth)

16426 ONE-DIMENSIONAL SUPERCONDUCTORS. Mayadas, A. F.; Laibowitz, R. B. (IBM Thomas J. Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev. Lett.; 28: No. 3, 156-8(17 Jan 1972).

Measurements are reported of the excess fluctuation conductivity in one-dimensional Al samples. Because sample diameters were so small (typically, square cross sections ~600 Å × 600 Å), it was possible to measure excess conductivity over a temperature range much wider than previously possible. Good agreement with the Thompson–Maki theory is observed at temperatures $T < 1.3T_c$. The recent theory due to Patton is also in qualitative agreement. Above $1.4T_c$ the data do not agree quantitatively with any theory. (auth)

16427 TUNNELING MEASUREMENTS OF THE SUPERCONDUCTING ENERGY GAP OF BULK POLYCRYSTALLINE INDIUM. Averill, R. F.; Straus, L. S.; Gregory, W. D. (Georgetown Univ., Washington, D. C.). Appl. Phys. Lett.; 20: No. 2, 55-6(15 Jan 1972).

A successful new technique for the fabrication of bulk indium tunnel junctions, In (bulk)/Al_2O_3/Pb, was developed and used to determine the value of the reduced energy gap as $2\Delta(0)/kT_c$ = 3.58 for bulk polycrystalline indium. (auth)

16428 SUPERCONDUCTIVITY IN ULTRATHIN $NbSe_2$ LAYERS. Frindt, R. F. (Simon Fraser Univ., Burnaby, B. C.). Phys. Rev. Lett.; 28: No. 5, 299-301(31 Jan 1972).

The superconducting resistive transition of the layer compound $NbSe_2$ was observed for crystals a few layers thick. The T_c decreases as the crystal thickness is reduced below six $NbSe_2$ layers, and a T_c of 3.8°K is predicted for a single layer. No significant increase in the transition width is observed as the number of $NbSe_2$ layers is reduced. The results are compared to recent work on intercalated layer compounds. (auth)

16429 CRITICAL-STATE MODEL OF BULK FLUX PINNING IN Pb-40Tl. Walmsley, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Appl. Phys.; 43: No. 2, 615-23(Feb 1972).

The Bean–London critical-state model is applied to the calculation of magnetic hysteresis in Pb–40 Tl. Two forms of the model are investigated in which the flux-line-pinning force density α_p has the field dependences $\alpha_p = \alpha_0(H_{c2} - H)/H_{c2}$ (law I) and $\alpha_p = \alpha_0 B^{\frac{1}{2}}(H_{c2} - H)/H_{c2}$ (law II). Intrinsic diamagnetism is carefully included in the calculation. The formulation of the problem is general to all Type-II superconductors but the numerical results are specific to Pb–40 Tl. Both the main hysteresis loop and subloops are computed. Experimental results are presented. After allowing for the effects of surface hysteresis, there is good agreement with the calculations based on law I but not with those based on law II. Critical fields for Pb–40 Tl at 4.2°K are $H_{c1} = 96.4 \pm 6$ Oe, $H_{c2} = 2884 \pm 35$ Oe, $H_c = 330 \pm 4$ Oe, and the three Ginzburg–Landau parameters are in good agreement: $\kappa_1 = 6.18$, $\kappa_2 = 6.15$, $\kappa_3 = 6.1 \pm 0.2$. (auth)

16430 PARAMAGNETIC IMPURITIES AND THERMAL STABILITY IN TYPE-II SUPERCONDUCTORS. Scanlan, R. M.; Livingston, J. D. (General Electric Corporate Research and Development, Schenectady, N. Y.). J. Appl. Phys.; 43: No. 2, 639-44(Feb 1972).

Magnetization, critical current, and flux-jump measurements were made on superconducting La_3In containing 1 at. % Gd. The previously reported nonmonotonic dependence of upper critical field on temperature was confirmed. A low-temperature high-field regime is observed where critical currents increase with increasing temperature. This leads to improved thermal stability, i.e., less flux jumping, at low temperatures. The Gd magnetization data are near free-ion values, indicating only slight interaction effects. (auth)

16431 EFFECT OF HYDRAULIC EXTRUSION ON THE COMPOSITION OF NIOBIUM STANNIDE [Nb_3Sn]. Vereshchagin, L. F.; Konyaev, Yu. S.; Berzon, E. M.; Veller, M. V.; Gulyutin, A. V. (Inst. of Physics of High Pressures, Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 198-9(Jul 1971). (In Russian).

The effect of hydraulic extrusion on the composition and superconducting properties of the compound Nb_3Sn was studied, using an x-ray microanalyser to reveal local changes in composition. The Nb content increased and the Sn content fell substantially with increasing degree of deformation, in agreement with the relative atomic dimensions of the constituents. The change in composition had a corresponding effect on the critical superconducting characteristics. (Metals Abstr.)

16432 MECHANICAL AND SUPERCONDUCTING PROPERTIES OF ALLOYS IN THE NIOBIUM–TITANIUM SYSTEM AND THEIR FIELD OF APPLICATION. Baykov, A. I.; Kuznetsova, M. I.; Mel'nikova, L. V. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; 32: 98-110(1971). (In Russian).

Alloys in the niobium–titanium system with a titanium concentration of more than 40 at. % have a higher critical magnetic field (H_{c2}) than in the case of niobium–zirconium and niobium–titanium–zirconium alloys. The highest magnetic field is attained on an alloy with 60 at. % titanium. 60T alloy wire is used for making superconducting solenoids. (tr-auth) (JPRS)

16433 INFLUENCE OF A COPPER STABILIZER COATING ON THE FORMATION OF A SUPERCONDUCTIVE PHASE OF V_3Ga OBTAINED BY A DIFFUSION METHOD. Kuznetsova, S. M.; Vorob'eva, N. S.; Sokolov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 12: No. 3, 339-40(May-Jun 1971). (In Russian).

A potential superconductor is the intermetallic material V_3Ga, which possesses high critical parameters. For its preparation, a V wire was passed through liquid Ga at 700°C, a Cu coating was electrochemically applied, and the product was annealed at 600 to 800°C. Comparison of coppered and uncoppered wires showed that the Cu hastened the formation of V_3Ga. (K.S.W.)

16434 PROPERTIES OF GALLIUM AND BERYLLIUM FILMS OBTAINED BY LOW-TEMPERATURE CONDENSATION. Lazarev, B. G.; Kuz'menko, V. M.; Sudovtsov, A. I.; Mel'nikov, V. I. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 32: No. 1, 52-7(Jul 1971). (In Russian).

The electric resistance of Ga and Be films condensed on a substrate held at liquid-helium temperature was studied in relation to the structure and thickness of the film and the thermal conditions involved. Thus the amorphous form of Ga (with a critical superconducting temperature of 8.5°K) only remained stable up to a thickness of 2000 Å. On further increasing the thickness, a crystalline form developed with a considerably lower critical temperature (6.5°K). The superconducting characteristics of Be also depended on thickness, the maximum value of 9°K occurring in films 90 Å thick. (Metals Abstr.)

16435 EFFECT OF THE QUALITY OF THE (NIOBIUM) CORE ON THE PARAMETERS OF NIOBIUM STANNIDE (Nb_3Sn). Krugliak, J. (Electrotechnical Inst., Bratislava). Fiz. Metal. Metalloved.; 32: No. 1, 217-19(Jul 1971). (In Russian).

The critical superconducting parameters of Nb_3Sn samples formed on the surface of a Nb strip by treating the latter in molten Sn were studied in relation to the quality of the Nb employed. The cold-rolled Nb strip was annealed at 1000°C for up to 30 min. With increasing annealing time, the critical superconducting current of the Nb_3Sn deposited on the Nb diminished; the critical parameters also varied in a complex manner with varying annealing temperature. The practical importance of these effects is indicated. (Metals Abstr.)

16436 NATURE OF THE SOFTENING OF METALS AT THE SUPERCONDUCTING TRANSFORMATION. Gindin, I. A.; Lazarev, B. G.; Starodubov, Ya. D.; Lebedev, V. P. (Physical-Technical Inst., Kharkov. Kharkov State Univ.). Fiz. Metal. Metalloved.; 31: No. 5, 1043-52(May 1971). (In Russian).

The temperature dependence of softening effects taking place in polycrystalline Pb subjected to creep conditions in the superconducting state was studied. The extent of the softening effect depended on the applied load as well as the prevailing temperature and the velocity of plastic yield of the metal. An anomalous temperature dependence of the effect (relative to that observed in other metals) occurred in the case of Pb. Tentative explanations for these and other analogous effects are presented on the basis of dislocation theory. (Metals Abstr.)

16437 DENSITY OF STATES IN INHOMOGENEOUS SUPERCONDUCTORS. Larkin, A. I.; Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 61: No. 5, 2147-59(Nov 1971). (In Russian).

Inhomogeneities of the effective interaction between electrons in superconductors result in smearing out of the state density maximum. The smearing out alters the volt–ampere characteristic of the tunnel junction and also the frequency dependence of electromagnetic field absorption in the superconductor. (auth)

16438 EFFECT OF DIELECTRIC COATING ON THE CRITICAL TEMPERATURE OF THIN SUPERCONDUCTING FILMS. Zharkov, G. F.; Uspenskii, Yu. A. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 61: No. 5, 2123-32(Nov 1971). (In Russian).

The role of a dielectric coating on the critical temperature T_c of thin superconducting films is considered within the framework of a model description of a superconductor ("jelly" model). For extremely thin films with almost two-dimensional electron motion, a formula is derived which qualitatively describes variation of the film T_c with the dielectric permeability of the coating $\epsilon(\omega)$. It is found that, for metallic films, the dielectric coating weakly alters the transition temperature. (auth)

16439 MAGNETIC FIELDS OF ROTATING SUPERCONDUCTORS. Verkin, B. I.; Kulik, I. O. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 61: No. 5, 2067-82(Nov 1971). (In Russian).

Quantum interference effects in rotating hollow thin-wall superconducting cylinders are investigated. It is shown that by suitable choice of the cylinder radius, wall thickness, and superconductor parameters, one can study the oscillating dependence of the London field on angular velocity ω for reasonable values of the latter when both the external field and angular velocity are effective. Stability of current states of the cylinder is analyzed, and it is shown that, for small radii, a large part of the descending branch of the "depairing curve" is stable and may be observed. (auth)

16440 QUANTIZATION OF MAGNETIC FLUXES IN SIMPLY CONNECTED SUPERCONDUCTING CYLINDERS. Shablo, A. A.; Dmitrenko, I. M. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1970-5(Nov 1971). (In Russian).

Results are presented from an experimental investigation of quantization of a magnetic flux in simply connected superconducting cylinders. The samples (filaments with diameters of the order

of a micron) are prepared from InPb containing from 0 to 5 at. % of Pb, which corresponds to a transition from Type-I to Type-II superconductivity. The phase diagram of the cylinders in a parallel field has an oscillating shape. The oscillation period decreases with reduction of the temperature. The oscillation amplitude increases with decrease of the sample cross section. The quantum oscillations remain in samples with $\kappa < 0.4$ and in pure In samples. This is ascribed to supercooling of the samples below the thermodynamic critical field. Qualitative agreement is observed with existing theoretical works on quantum transitions in continuous cylinders with surface superconductivity. (auth)

16441 EFFECT OF IMPURITIES ON THE TOPOLOGY OF THE INDIUM FERMI SURFACE. II. Makarov, V. I.; Volynskii, I. Ya. (Physical-Technical Inst., Kiev). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1928-40(Nov 1971). (In Russian).

The dependence of $\partial T_c/\partial P$ and ΔT_c on impurity concentration, C, is studied in a broad range of concentration values in the In–Tl and In–Hg systems in both the tetragonal and cubic phases. Peculiarities of the dependence of $\partial T_c/\partial P$ on C are observed in the tetragonal phase for concentrations between 0 and 3 at. % Hg in the In–Hg system and between 0 and 6 at. % Tl in the In–Tl system. At high concentrations, peculiarities of the dependence of $\partial T_c/\partial P$ on C are observed in the 6 to 9% concentration range of Hg for the In–Hg system and in the 22 to 30% range of Tl in the In–Tl system. A singularity of $\partial T_c/\partial P$ is observed in the cubic phase of the In–Tl system at Tl concentrations between 32 and 50 at. % and also in the triple system In–Tl (35 at. %)–Hg (x at. %) ($0 < x < 6$ at. %). The singularities are ascribed to alteration of the Fermi surface topology induced by the impurity. It is suggested that in alloys there exist singularities in the density of the electron states that form a coherent state, i.e. Cooper pairs. On the other hand, from the viewpoint of modern theory of normal metals, it is meaningless to speak of singularities of the electron state density in these alloys. (auth)

16442 TEMPERATURE DEPENDENCE OF THE CREEP STRAIN JUMP IN LEAD AND INDIUM AT THE TRANSITION TO SUPERCONDUCTIVITY. Soldatov, V. P.; Startsev, V. I.; Vainblat, T. I. (Physical-Technical Inst. of Low Temperature, Kharkov). Phys. Status Solidi (b); 48: No. 1, 381-6(1 Nov 1971).

The temperature dependence of the creep strain jump was investigated for Pb and In single and polycrystals of 99.999% purity in the region of the N → S transition. To achieve the strain jump, the creeping sample was switched from the normal to superconducting state by taking off the magnetic field, $H > H_c$, of the solenoid that contained the sample. A temperature run was followed in the range 1.65 to 4.2°K for lead and 1.65 to 3.4°K for indium. The magnitudes $\Delta\epsilon(T)$ of the step in creep strain at various temperatures were reduced to the value at T = 0°K and the curve $\Delta\epsilon(T)/\Delta\epsilon(0) = f(T/T_c)$ was fit to $\Delta\epsilon(T)/\Delta\epsilon(0) = \alpha(T/T_c)^2$ in the interval $0.2 \leq T/T_c \leq 1$. Possible mechanisms are discussed that might be responsible for the jump of the creep strain at N → S. (auth)

16443 FLUX FLOW IN TYPE-I AND -II SUPERCONDUCTING FILMS. Ogushi, Tetsuya; Shibuya, Yoshio (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap.; 32: No. 2, 400-15(Feb 1972).

Experimental results on the linear and nonlinear V–I plots, which appear intrinsically in Type-I and Type-II superconducting thin films, are discussed in terms of the relevant theories, especially that of a long-range Coulomb-type interaction between vortices. The V–I plots are quite linear for films with relatively large κ values near T_c and at low temperatures in low applied magnetic fields. They show similar behavior to those of bulk superconductors. However, these properties become obscure because of the appearance of nonlinear V–I plots in higher magnetic fields than that in which the lattice spacing of vortices "a" $\ll (2 \times 2\lambda^2)/d$, where d is the film thickness and λ is the penetration depth. The behavior of the V–I plots in this region seems to be explained by assuming a fluid-like vortex structure. (auth)

16444 FLUX-LINE LATTICES OF PURE TYPE-II SUPERCONDUCTORS WITH ANISOTROPIC FERMI SURFACE. Takanaka, Kenji (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 46: No. 5, 1301-6(Nov 1971).

In the mixed state of pure (single-crystal) Type-II superconductors with anisotropic Fermi surfaces, the flux-line lattices depend on the anisotropy of the Fermi surface. Near the transition temperature a triangular lattice is stable, but at lower temperatures other lattice structures will occur, depending on the magnitude of the anisotropy and the direction of the applied magnetic field relative to the crystal axis. Furthermore, the anisotropy will remove the degeneracy for the direction of the array of the flux line. (auth)

16445 NEUTRON DIFFRACTION BY VORTEX LATTICES IN SUPERCONDUCTING Nb AND $Nb_{0.73}Ta_{0.27}$. Schelten, J.; Ullmaier, H.; Schmatz, W. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (b); 48: No. 2, 619-28(1 Dec 1971).

Neutron-diffraction experiments on flux line lattices in superconducting Nb and NbTa are reported. From experimental data (form factors, lattice parameters, rocking curves, etc.) the following results are obtained: the microscopic flux distribution of a single flux line in NbTa could be determined; for Nb, the form factors are compared with a theory valid in the vicinity of H_{c2}; a correlation between the flux-line lattice and the crystal lattice was found; and finally, the attractive interaction between neighboring flux lines in Nb was verified, and the resulting maximum lattice parameter was compared with the corresponding distance in recent nonlocal calculations. (auth)

16446 EFFECT OF NIOBIUM ON SUPERCONDUCTING PROPERTIES OF AN EQUIATOMIC ALLOY OF VANADIUM AND TITANIUM. Efimov, Yu. V.; Baron, V. V. pp 173-7 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

Studies were made of the effect of Nb (≤10 at. %) on the structure and properties of a V alloy containing Ti 50 at. %. These ternary alloys are single-phase solid solutions with a bcc lattice. The properties studied included hardness, strength, ductility, T_c (the temperature for the transition into the superconducting state), and the critical current. Addition of Nb 10 at. % changed the lattice constant from 3.138 to 3.116 Å. Alloying with Nb raised both the hardness and the strength of the binary alloy while the ductility of cold-worked wire remained effectively unchanged with an elongation of 2 to 3% and T_c was lowered from 7.8 to 7.1°K. A sharp reduction in critical current of the wire occurred when Nb was >0.5 at. %. (Referativnyi Zh.)

16447 STRUCTURE AND SUPERCONDUCTIVITY OF SINGLE CRYSTALS OF NIOBIUM CONTAINING 5 AND 10 PERCENT ZIRCONIUM. Savitskii, E. M.; Myzenkova, L. F.; Baron, V. V.; Martynova, L. F. pp 148-55 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

A study was made of the structure of Nb single crystal alloys containing Zr 5 and 10% prepared by electron-beam zone melting. The Zr and interstitial-impurity distributions along the length of the single crystal rod were determined. The superconducting transition temperatures were 10 and 10.5°K for the 5 and 10% Zr alloys, respectively. Curves are given for the magnetization of specimens having various crystallographic orientations. (Referativnyi Zh.)

16448 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF CAST ALLOYS IN THE NIOBIUM–TIN SYSTEM. Savitskii, E. M.; Baron, V. V.; Mikhailov, B. P. pp 99-105 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

Structure (by micro- and macro-structure analysis) and phase composition of billets of Nb–Sn alloys were studied. Nb–Sn billets of various dimensions and shapes, with Sn contents of up to 50%, could be produced having adequate distribution of the components. The temperature of the transition to the superconducting state of these alloys was 17.5 to 18.0°K. (Referativnyi Zh.)

16449 SUPERCONDUCTING METALLIC COMPOUNDS. Savitskii, E. M.; Efimov, Yu. V. pp 71-88 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

The relationships involved between the critical temperature and various other parameters of metallic compounds are considered. The latter include the crystal structure type, degree of order, electron structure chemical composition, and conditions of formation of the compounds. Effects of pressure, interstitial impurities, alloying, heat treatment, and other factors on the superconducting properties and structure of various compounds are analyzed. 69 references. (Referativnyi Zh.)

16450 METHODS OF DESCRIBING THE MAGNETIC HYSTERESIS OF HARD SUPERCONDUCTORS. Potapov, N. N. pp 65-70 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

Questions relating to the use of various physical values for characterizing the magnetic hysteresis of hard superconductors are discussed. Some results are given from a study of the magnetic hysteresis at 4.2°K of sintered Nb–Sn alloys in the Nb_3Sn composition region. These results are used to compare the hysteresis values for specimens cooled below the critical temperature with and without the application of a magnetic field. (Referativnyi Zh.)

16451 VANADIUM–SCANDIUM AND NIOBIUM–SCANDIUM SYSTEMS AND THEIR SUPERCONDUCTING PROPERTIES. Savitskii, E. M.; Baron, V. V.; Naumkin, O. P.; Efimov, Yu. V. pp 178–86 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

Data from the authors' work and from the literature were used in studies of the laws relating to changes in T_c of superconducting alloys of simple eutectic systems of transitional and nontransitional metals and also of the eutectic regions of the phase diagrams of binary systems forming intermediate compounds. Composition/T_c diagrams and phase diagrams are given for V–Sc and Nb–Sc binary systems. T_c is either raised or lowered with solution of the second component within the limits of homogeneity of the solid solution. In two-phase eutectic systems, T_c of each of the superconducting phases changes with the alloy composition changes along an almost horizontal line. 25 references. (Referativnyi Zh.)

16452 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF ALLOYS BASED ON THE COMPOUND Nb_3Sn OBTAINED BY PHASE SUBSTITUTION IN THE SOLID–LIQUID STATE. Savitskii, E. M.; Baron, V. V.; Mikhailov, B. P. pp 112–19 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

The replacement of the easily fusible phase in Nb–Sn alloys by other superconducting elements, e.g., Pb–Sb, and Pb–Bi, which have a superconducting transition temperature of 7.1 to 8.2°K, is described. The effect of the structure on the superconducting properties is shown. The alloys prepared had significant ductility and were capable of plastic deformation. (Referativnyi Zh.)

16453 FLUX-FLOW PROPERTIES OF Cu/Nb/Cu JUNCTIONS. Thys, W.; Folens, G.; Bouwen, A.; Van Gerven, L. (Univ., Leuven, Belg.). pp V355–62 of International Conference on the Physics and Chemistry of Semiconductor Heterojunctions and Layer Structures. Vol. V. /Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971).

From International conference on the physics and chemistry of semiconductor heterojunctions and layer structures; Budapest, Hungary (11 Oct 1970).

The critical current density J_{tc} and the pinning force density F_p were studied as a function of magnetic induction B and temperature T for different Cu coatings on Nb foils. J_{tc} was fitted to the equation $J_{tc} = \alpha B^{\gamma-1}$; γ, the anisotropy parameter of the vortex lattice, was found to decrease with T, becoming negative near T_c, and to increase with the Cu thickness. The F_p data are analyzed using a pinning model; F_I, the netto-interaction force density per unit Lorentz force density F_L, decreases with increasing Cu thickness. F_I is separated into bulk and surface contributions, and the range S of the surface behavior is plotted vs $B/\mu_0 H_{c2}$. The effect of a thick Cu coating is to decrease S drastically until it is on the order of λ and ξ. The microscopic theory of De Gennes is used to understand this behavior. (D.L.C.)

16454 INFLUENCE OF MAGNETIC SCATTERING ON THE TUNNEL CURRENT OF SUPERCONDUCTORS. Zavaritskii, N. V.; Grigor'ev, V. N. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 2, 73–6(20 Jul 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 2, 112–16(20 Jul 1971).

The iron magnetic scattering impurities were deposited on the insulator layer of the tunnel junction on the side of the investigated superconducting metal. The insulation layer was produced by oxidizing an aluminum film. The superconductors investigated were tin and lead. The $dV/dI = R(V)$ characteristics of the samples were recorded. It is noted that in the normal state of the metal (in a field $H > H_c$ or at $T > T_c$,) no symptoms of any giant anomalies at V = O were observed. (M.H.R.)

16455 TUNNELING MEASUREMENTS OF THE SUPERCONDUCTING DENSITY OF STATES IN Cu CLEAN FILMS BACKED BY LEAD. Nedellec, P. (Paris Univ., Orsay, France); Dumoulin, L.; Guyon, E. Solid State Commun.; 9: No. 23, 2013–15(1 Dec 1971).

A tunneling study of the geometrical resonance effects in Cu films in proximity with thick superconducting Pb films is presented. From a study of the Cu thickness dependence, it is possible to separate the effect of the "Tomasch" oscillatory behavior and that of the induced strong coupling due to the Pb. (auth)

16456 NUCLEAR MAGNETIC RESONANCE IN Nb_3Al AND $Nb_3Al_{0.8}Ge_{0.2}$. Alekseevskii, N. E.; Krasnoperov, E. P. (Inst. of Physical Problems, Moscow). Dokl. Akad. Nauk SSSR; 197: No. 5, 1048–50(11 Apr 1971). (In Russian).

The NMR associated with the ^{27}Al nuclei in superconducting alloys of the Nb_3Al–Nb_3Ge system was studied and correlated with the crystal structure and superconducting parameters of the corresponding materials. The critical temperature of pure Nb_3Al is 17°K, while that of the three-component alloys, after heat treatment, in some cases reached nearly 20°K. The increase in critical temperature was ascribed to ordering processes and the increased electron–phonon interaction associated with these, as clearly reflected in the NMR measurements. (Metals Abstr.)

16457 PARALLEL CRITICAL MAGNETIC FIELDS OF Pb/Cu DOUBLE LAYERS. Martinoli, P. (Swiss Federal Inst. of Tech., Zurich). Solid State Commun.; 9: No. 24, 2177–81(15 Dec 1971).

The parallel nucleation field $H_{c\parallel}$ was measured in Pb/Cu double layers as a function of the thickness of the superconducting film. The experimental data are compared with calculations based on the de Gennes–Werthamer theory of proximity effects. It is shown that this theory, originally derived for the dirty limit, provides a useful basis for the discussion of data taken in the pure limit when the coherence length is suitably interpreted. (auth)

16458 PRESSURE ENHANCED SUPERCONDUCTIVITY IN $NbSe_2$. Jerome, D. (Laboratoire de Physique du Solide, Orsay, France); Grant, A. J.; Yoffe, A. D. Solid State Commun.; 9: No. 24, 2183–5(15 Dec 1971).

The superconducting transition temperature T_c of the layer crystal niobium diselenide was found to increase from 6.9 to 8.5°K on the application of a hydrostatic pressure of nearly 17 kbar. This corresponds to one of the highest-known pressure coefficients $dT_c/dP = 9.5 \times 10^{-6}$ deg/bar. Evidence for two-dimensional fluctuations is found above T_c. (auth)

16459 MAGNETIC CONTRIBUTION TO THE LOW TEMPERATURE SPECIFIC HEAT OF V_3Si IN THE MIXED SUPERCONDUCTING STATE. Goldberg, I. B. (Hebrew Univ., Jerusalem). Solid State Commun.; 9: No. 24, 2215–17(15 Dec 1971).

In V_3Si it was found that there is a magnetic contribution to the specific heat in the mixed superconducting state of the form $C_m = \gamma_m HT + a_m HT^3$. It is shown that the field and temperature dependence of C_m and the measured values of γ_m and a_m can be accounted for in terms of flux line penetration at fields slightly higher than H_{c_1}. (auth)

16460 ANISOTROPY IN THE LENGTH CHANGE OF GALLIUM SINGLE CRYSTALS AT THEIR SUPERCONDUCTING TRANSITION. Ott, H. R. (Eidgenoessische Technische Hochschule, Zurich). Solid State Commun.; 9: No. 24, 2225–8(15 Dec 1971).

The magnetostriction of gallium single crystals was measured for the three principal axes between 0.3 and 1.1°K. It is found that the length change at the transition from the superconducting to the normal state is given approximately by $(\Delta l/l)_a = -3 \times 10^{-9}$, $(\Delta l/l)_b = +4.4 \times 10^{-9}$, and $(\Delta l/l)_c = +1.8 \times 10^{-9}$, for the a, b and c axes at T = 0 K. A short discussion of the results with respect to microscopic theory is presented. (auth)

16461 ABSOLUTE MEASUREMENT OF THE AMPLITUDE OF ac JOSEPHSON EFFECT IN A SUPERCONDUCTING WEAK LINK. Bolton, J. E. (Univ. of Chicago); Douglass, D. H. Jr. Solid State Commun.; 9: No. 24, 2263–4(15 Dec 1971).

Absolute measurement of the amplitude of the ac Josephson effect in a superconducting weak link was achieved, thus resolving the previous discrepancies between theory and experiment. (auth)

16462 INTERACTION DISTANCE BETWEEN FLUX LINES AND PINNING CENTRES. Campbell, A. M. (Cambridge Univ., Eng.). J. Phys., C (London); 4: No. 18, 3186–98(31 Dec 1971).

It has previously been reported that, at low amplitudes, the response of pinned flux lines to a ripple field is linear and reversible, in contradiction to the Bean model. It is shown that this can be explained by the elastic movement of flux. The results allow the force exerted on the flux lines by the lattice to be calculated as a function of their displacement from equilibrium. It is found that unpinning first occurs for displacements of about 30 Å but that the full critical state is not built up until they have moved about 400 Å. One result is that the ac losses are less than would be calculated from the Bean model, and this is confirmed by the experimental measurements. (auth)

16463 NEW EFFECTS IN THE ABSORPTION OF ULTRASOUND IN THE INTERMEDIATE STATE OF A VERY PURE SUPERCONDUCTOR. Shepelev, A. G.; Ledenev, O. P.; Filimonov, G. D. (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 14: No. 7, 290–4(5 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 7, 428–33(5 Oct 1971).

Some results obtained in an investigation by a pulsed method of the absorption of longitudinal ultrasound of frequency 50 to 190 MHz in the intermediate state of pure gallium are presented.

Measurements at temperatures down to 0.32°K were carried out in a cryostat using absorption pumping-off of the vapor of ~25 cm^3 of liquid He^3. The dependence of the ultrasound absorption function in gallium at constant temperature was determined. A maximum of the monotonic absorption of longitudinal ultrasound was obtained experimentally in the intermediate state of the very pure superconductor. (M.H.R.)

16464 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF VAPOUR-DEPOSITED Nb_3Sn CONDUCTOR MATERIAL. Hart, Peter Brian; Hill, Christopher; Wilkins, Clifford William (to Plessey Co. Ltd.). British Patent 1,260,300. 12 Jan 1972. Filed 24 Apr 1968.

The process described is claimed to provide an improved vapour-deposition method for production of Nb_3Sn of high and consistent critical current density (J_c). Deposition is effected in the presence of O_2 by H_2 reduction of the chlorides of Nb and Sn in the vapour state on a heated substrate. The gas stream contains between 0.05 and 5 vol. % of O_2 (preferably about 0.5%), and the substrate is maintained at about 800°C. The substrate may consist of Hastelloy. It is thought that precipitation of a Nb–O phase takes place and that the precipitates act as flux-priming centres, thus increasing critical current density. (UK)

Equipment and Devices

Refer also to abstract 15867.

16465 (KHFTI-70-30) MEASUREMENT OF THE FIGURE OF MERIT OF A SUPERCONDUCTING RESONATOR BY MEANS OF A TRAVELLING WAVE TUBE. Zykov, A. I.; Knyazev, B. R.; Kheifets, M. I.; Kuznetsov, A. D. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1970. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

A method of measurement of the characteristic figure of merit of resonators is described. The schematic of a superhigh-frequency modulator is discussed. Measurement of the attenuation decrement of superhigh-frequency oscillations was correct to within 1%. Computation of the figure of merit of a feed-through resonator is illustrated with the necessary formulas. Results are given for the calculation of figures of merit of resonators with a superconducting lead sheath deposited by cathode sputtering. (tr-auth)

16466 METHOD OF PRODUCING AN ELECTRICAL CONDUCTOR HAVING A SURFACE LAYER OF SUPERCONDUCTIVE MATERIAL. Scheffler, Ernst; Ziemek, Gerhard (to Kabel- und Matallwerke Gutehoffnungshuette Aktiengesellschaft). British Patent 1,260,974. 19 Jan 1972. Priority date 12 Mar 1969, Germany.

A method of producing an electrical conductor with a surface layer of superconducting material, suitable for use in cables cooled to very low temperatures, is described. The surface layer is composed of a superconducting alloy and/or compound comprising two or more constituents. One or more of these constituents are introduced by diffusion by heat treatment. A strip consisting of a constituent with a melting point above the diffusion temperature is fed longitudinally towards, and formed into a tube around, an elongated carrier having on its surface a layer of the constituent with the lowest melting point in the conductor structure. The edges of the tube so formed are welded together, and the tube is drawn down at least onto the layer provided on the carrier. The conductor so produced is subsequently subjected to heat treatment. (M.H.R.)

16467 PREPARATION AND SUPERCONDUCTING PROPERTIES OF A VANADIUM MULTI-CORE CABLE DIFFUSION-COATED WITH GALLIUM. Vorob'eva, N. S.; Kunakov, Ya. N. pp 106-11 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

Diffusion regimes for coating Ga onto a V multi-core micro cable with a wire dia. of 40 to 100 μm were studied. The amount of Ga deposited during hot metallization depends on the micro cable configuration and conditions of deposition. A heat-treatment regime for the Ga-coated micro cable is described that will produce the superconducting compound V_3Ga. The superconducting properties were measured. (Referativnyi Zh.)

16468 CRYOGENIC PARTIALLY STABILIZED SUPERCONDUCTING QUADRUPOLE MAGNET. Eckert, D.; Lange, F. Exp. Tech. Phys.; 19: No. 4, 277-87(1971). (In German).

Design and testing of a superconducting quadrupole magnet are described. In order to avoid degradation, a cryogenic partially stabilized superconducting coil was used. With this form of stabilization it is possible to raise the current a small amount above the critical value without driving the coil into the normal state. By means of partial stabilization it is possible to achieve relatively high current densities in the winding. The quadrupole magnet has an outer diameter of 14.2 cm. With an overall current density of 1.3×10^4 A/cm^2, the magnet has a flux density gradient of 50 tesla/m in a region with a diameter of 5 cm and a length of 30 cm (auth)

16469 CRYOGENIC SYSTEM FOR A LARGE SUPERCONDUCTING MAGNET. Eckert, D.; Lange, F. Exp. Tech. Phys.; 19: No. 4, 271-6(1971). (In German).

A cryogenic system for a superconducting magnet of a mass of 35.5 kg is described. In spite of 200-A current leads and mechanical connections for the transmission of a moment of force of 250 Mkp and of a sidewise directed force of 25 kp, small quantities of cooling liquids are needed due to partial utilization of the enthalpy of the evaporated cooling liquid. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 15270, 15361, 15801, 16445, 16842, and 17161.

16470 (ANCR-1034) POTENTIAL OF A LASER-INDUCED FUSION DEVICE AS A THERMAL NEUTRON SOURCE. Brugger, R. M. (Aerojet Nuclear Co., Idaho Falls, Idaho). Nov 1971. Contract AT(10-1)-1375. 34p. Dep. NTIS.

Anticipating that a laser-induced fusion reaction will eventually be achieved, the potential of such a system as a source of thermal neutrons is considered. This source should provide bursts of thermal neutrons which would be at least three orders of magnitude more intense for time-of-flight experiments than the best existing neutron source. The major limiting factor appears to be the shock produced when each pellet reacts; this shock must be contained within the target room and should not destroy the moderators. Estimates indicate that this shock can be controlled. Consideration is also given to moderator design, shielding, beam tube windows and backgrounds. (auth)

16471 (BNL-16159) NORMALIZATION OF THE RESOLUTION FUNCTION FOR INELASTIC NEUTRON SCATTERING AND ITS APPLICATION. Dorner, B. (Brookhaven National Lab., Upton, N. Y. Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Sep 1971. 37p. Dep. NTIS.

By extending the considerations of Maier-Leibnitz, the normalization of the resolution function is found to be the product of the volumes in reciprocal space of the incident and scattered beams. Each volume is defined by an integration in reciprocal space over the probability of finding a particular $\vec{k}$, where $\vec{k}$ is the wave vector of the neutron. The resolution can be understood as a convolution of these two volumes. For three-axis spectrometers explicit expressions for these volumes are given. The knowledge of the normalization is necessary for numerical unfolding of experimental data. For two cases, which often occur in inelastic neutron scattering, it is possible to directly correct the experimental data without resorting to numerical unfolding. After applying these corrections the data represent the scattering law folded with a resolution function normalized to unity, i.e., the integral over the corrected data is the integral over the scattering law. It is shown that in this case, the unfolding of the corrected data turns out to be a one-dimensional problem. (auth)

16472 (ITF-71-43-P) INELASTIC SCATTERING OF SLOW NEUTRONS IN IMPERFECT CRYSTALS. I. THE COHERENT EFFECTS DUE TO THE LOCALIZED VIBRATIONS OF SUBSTITUTIONAL ATOMS. Dzyub, I. P.; Kochmarskii, V. Z. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 27p. (In Russian). Dep. NTIS (U. S. Sales Only).

An expression is obtained for the double differential cross section of slow-neutron scattering by localized vibrations in crystals with the Bravais lattice when the concentration of impurities is small. It is shown that the dependence of the coherent part of the scattering cross section upon the neutron transfer momentum allows one to judge the force-constant change matrix. Numerical calculation is made of the scattering cross section for the model of a simple cubic lattice. (auth)

16473 (JINR-E4-6171) THEORY OF COHERENT NEUTRON SCATTERING BY HYDROGEN-BONDED FERROELECTRICS AT LOW TEMPERATURES. I. GENERAL EXPRESSION FOR INELASTIC COHERENT SCATTERING OF SLOW NEUTRONS AND EFFECTIVE THERMAL FACTORS. Stamenkovic, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 17p. Dep. NTIS (U. S. Sales Only).

The differential cross section for inelastic coherent scattering of slow neutrons scattered by hydrogen-bonded ferroelectrics at low temperatures has been evaluated. The quasi-spin form factors have been calculated using the Blinc's model. The proton (deuteron)-lattice interaction is taken into account and an effective Debye-Waller factor is introduced. (auth)

16474 (JINR-E4-6172) THEORY OF COHERENT NEUTRON SCATTERING BY HYDROGEN-BONDED FERROELECTRICS AT LOW TEMPERATURES. II. SCATTERING CHARACTERISTICS AND VARIOUS CONCEPTIONS OF THE TUNNELING QUASI-SPIN MODEL. Stamenkovic, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 19p. Dep. NTIS (U. S. Sales Only).

To check on experimentally the dispersion law of the polarization ("quasi-spin wave-like") mode, the characteristics of quasi-elastic neutron scattering at small angles are studied in KDP-type ferroelectrics. The various conceptions of the tunnelling quasi-spin model, the nature of the low-temperature polar phase, as well as the vibration of tunnelling particles along the axis of anisotropy are discussed with reference to the coherent neutron scattering. (auth)

16475 (JINR-P4-6066) NEUTRON SCATTERING BY HIGHLY ANHARMONIC CRYSTALS. Plakida, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

The scattering of neutrons on the basis of the theory of highly anharmonic crystals developed recently is discussed. The one-phonon inelastic cross section and the Debye-Waller factor are calculated with explicit account of all orders in the momentum transfer and anharmonic interactions. It is shown that due to the interference between the one-phonon and multiphonon scattering, the position and the shape of the one-phonon peaks strongly depend on the neutron momentum transfer in the highly anharmonic crystals. (auth)

16476 (SC-T-713076) SEALED-TUBE PULSED NEUTRON GENERATORS. Faure, C. Translated for Sandia Labs., Albuquerque, N. Mex., from Acta Electron.; 13: No. 4, 317-64(1970). 118p. Dep. NTIS.

An attempt is made to set down the general principles of operation of pulsed neutron generators in the form of sealed tubes. The problem of targets, their impregnation with tritium, the calculation of the neutron yield, and the determination of neutron pulses are considered. The physical phenomena involved, such as space charge or breakdown, are next examined to establish the electrical operating characteristics and the limiting performance. A review is then presented of the various possibilities available, in particular as regards the choice of the ion source. In addition, the operation of two types of tubes is studied: the occluded gas ion source tube and the high-voltage discharge tube. (auth)

16477 (UCRL-73550) LIVERMORE PULSED SPHERE MEASUREMENTS APPLIED TO RADIATION TRANSPORT IN AIR. Hansen, Luisa F.; Anderson, John D.; Kammerdiener, John L.; Wong, Calvin (California Univ., Livermore. Lawrence Livermore Lab.). 10 Nov 1971. 24p. (CONF-711125-3). Dep. NTIS.

From Radiation Shielding Information Center seminar-workshop; Oak Ridge, Tenn. (15 Nov 1971).

The problem of neutron transport in air was approached by making pulsed sphere measurements on liquid nitrogen and liquid oxygen. Emission spectra measurements were made for comparison with the predictions of the neutron transport calculated with the Monte Carlo transport code SORS. Because of the serious disagreements found for both nitrogen and oxygen, steps were taken to improve the calculations. (M.H.R.)

16478 PULSED NEUTRON MEASUREMENTS IN WATER NEAR AND BELOW ROOM TEMPERATURE. Williams, Peter MacLellan. College Park, Univ. of Maryland (1971). 148p. University Microfilms Order No. 71-25,972.

Thesis.

The thermal neutron diffusion coefficient was measured in water at room temperature and below using the pulsed neutron technique. Values at 30.1°C and 25.0°C of $36.3 \pm 0.9 \times 10^3$ cm^2/sec and $35.4 \pm 0.9 \times 10^3$ cm^2/sec, respectively agree well with with previous recent measurements. Below room temperature at 13.8°C and 7.5°C the respective diffusion coefficients of $32.5 \pm 0.9 \times 10^3$ cm^2/sec and $30.8 \pm 0.9 \times 10^3$ cm^2/sec were significantly less than limited earlier data. The present data, when joined with recent data in ice indicate a continuity of the diffusion coefficient across the ice-water phase transition on the basis of a constant number density of H_2O molecules. The present measurements and the observation of a continuity at the phase change are consistent with an analysis based on elementary scattering theory applied to recent models for water. These recent models picture water molecules as large hydrogen-bonded polymers similar in structure to ice. Four models for neutron scattering in water (Nelkin's, Haywood's, McMurry's and Russel's, and Radkowsky's) were reviewed for their abilities to predict the temperature dependence of the thermal neutron diffusion coefficient, particularly in regard to the inflection below room temperature. None of these models were satisfactory over the complete range of experimental data available. As a consequence of this review a wholly empirical formula for the density-weighted thermal neutron diffusion coefficient, $D\rho$ in gm/cm^2 is presented

and recommended for temperatures, T, in °K ranging between 180 and 360. In the course of the present research experimental errors affecting the accuracy of pulsed neutron measurements were investigated. The principal error source for the present work was found to be due to fast neutrons which on reflection from the building and other structures entered the test specimen at times up to a millisecond after the initial pulse and interfered with the measurements of pulse decay. A computer program was written which analyzed the measured pulse decay by the method of least squares and simultaneously corrected the measurements for the room-return effect by a quadratic fit. Recommendations are made on procedures to significantly improve the accuracy of the pulsed neutron technique. A more accurate technique is viewed as a valuable scientific tool in determining or verifying the molecular size in hydrogenous liquid moderators. Thus the pulsed neutron technique has the potential for aiding such research areas as the study of the liquid state or the study of the process of polymerization. (Diss. Abstr. Int., B)

16479 CURRENT PROBLEMS IN NEUTRON SCATTERING. Proceedings of the Symposium Held at Casaccia Center, Rome, Italy, 24th–27th September 1968. Seri Simposi. Rome; Comitato Nazionale Energia Nucleare (1970). 262p. (CONF-680990).

Ten reviews are presented on the following topics: lattice dynamics, liquid state, paramagnets, spin-wave theories, critical scattering, magnetization density in ordered systems, scattering of neutrons by spin waves, neutron diffraction, atomic motion in simple liquids, and magnetic coupling in rare earth metals and alloys. (D.L.C.)

16480 TWO-GROUP NEUTRON TRANSPORT THEORY WITH ANISOTROPIC SCATTERING. Reith, R. J. Jr.; Siewert, C. E. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 47: No. 1, 156-62(Jan 1972).

Solutions to the two-group neutron transport equation relevant to linearly anisotropic scattering are developed, and full-range expansion and orthogonality theorems are discussed. In addition to the general forms given, explicit solutions are presented and all necessary normalization integrals are evaluated. (auth)

16481 STEADY-STATE NEUTRON SPECTRA IN ICE IN THE TEMPERATURE RANGE 268 TO 4°K. Gangwani, G. S.; Tewari, S. P.; Kothari, L. S. (Univ. of Delhi). Nucl. Sci. Eng.; 47: No. 1, 153-6(Jan 1972).

The production of cold neutrons has been examined theoretically with a one-phonon plus two-phonon scattering kernel at temperatures down to 4°K. The results agree reasonably well with those from the experiments of Whittemore. It is observed that reducing the temperature below 40°K does not change the steady-state neutron spectrum significantly. (auth)

16482 NUCLEAR PHYSICS AND INTERACTION OF PARTICLES WITH MATTER. Skobel'tsyn, D. V. (ed.). Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 1-269 (1971).

Translated from Tr. Fiz. Inst., Akad. Nauk SSSR; 44: 1-269 (1971).

Separate abstracts were prepared for each of the 6 chapters in this volume. (R.W.R.)

For abstracts of individual chapters see: 15267, 16483, 16484, 16487, 16577, and 16848.

16483 NEUTRON-TRANSFER THEORY FOR INHOMOGENEOUS MEDIA. Stepanov, A. V. Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 193-247(1971).

The transport of neutrons in an inhomogeneous medium is described by using a statistical approach. An equation for the average Green's function of the kinetic equation is derived in a first nonvanishing approximation of the perturbation theory for the "mass operator". When the ensuing terms of the perturbation-theory series are taken into account, the higher moments of the distribution law must be calculated. In the event that the fluctuations in the medium obey a normal (Gaussian) distribution law, the Feynman graph method is useful for developing the perturbation-theory series. The correction functions for various models of diffusion media are presented. An approximate average Green's function that describes the diffusion of thermal neutrons in an inhomogeneous infinite medium is derived. In the particular case of a plane lattice, it is shown that the constants for the attenuation of the neutron flux agree with the results obtained in other ways. The relaxation length of the average neutron flux is derived; this average flux satisfies the single-velocity stationary kinetic equation involving isotropic scattering. Nonstationary diffusion of thermal neutrons and the energy dependence of the flux of diffusing neutrons are discussed. Estimates of the subsequent terms of the series of perturbation theory are calculated, and an expression for the average neutron flux in a medium with large-scale fluctuations and a Gaussian distribution law is derived. An equation in functional derivatives which is satisfied by the average neutron flux in any type of medium with fluctuating parameters and an approximate equation for the mean square of the neutron flux are found. The energy distribution of moderated neutrons is considered; the distribution function is averaged over the fluctuations of the absorption cross section. (13 figures) (R.W.R.)

16484 MODEL OF A HEAVY MODERATOR AND AN ANALYTICAL SOLUTION OF THE NEUTRON THERMALIZATION PROBLEM. Kazarnovskii, M. V. Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 248-69(1971).

The general properties of a neutron-scattering operator for a heavy moderator are considered. The conditions that must be fulfilled by the operator are listed. A model of the scattering operator is suggested; this model satisfies all the conditions and includes three arbitrary functions of the velocity and the scattering angles of the neutrons. The functions can be chosen so that the best approximation to the neutron-scattering law in a real moderator is obtained. Several methods for approximating the real scattering operator are discussed. The distribution function of the neutron velocities is determined in integral form. The case of the arbitrary (nonstationary) source is treated, and a short discussion of the eigenvalues and eigenfunctions of the neutron-transfer equation is given. (R.W.R.)

16485 RELATIONS BETWEEN ATOMIC TRANSPORT COEFFICIENTS IN SIMPLE LIQUIDS AND MOMENTS OF NEUTRON SCATTERING FUNCTIONS. Gyorffy, B. L.; March, N. H. (Univ. of Sheffield, Eng.). Phys. Chem. Liquids; 2: No. 4, 197-212(Oct 1971).

A possible alternative to Kubo theory is discussed for relating atomic transport coefficients in simple liquids. The arguments used result in a new expansion, in which the density–density response function χ is expanded in a power series in the self-response function χ_s. The coefficients of this expansion can be determined, in principle, to all orders, from the moments of the neutron scattering functions $S(q\omega)$ and $S_s(q\omega)$. It is then proposed, by appeal to the hydrodynamic equations, that the radius of convergence of this series can be used to relate diffusion to the sound wave attenuation coefficient. Finally, this $\chi-\chi_s$ expansion allows a direct comparison of the exact theory with earlier approximate theories relating incoherent and coherent neutron scattering from liquids. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 15288 and 16482.

16486 TABLES OF σK/M AND σ_{abs}/M. Okada, Minoru (Japan Atomic Energy Research Inst., Tokai). Radioisotopes (Tokyo); 20: No. 11, 620-30(Nov 1971).

By use of known values for σ, σ_{abs}, K and for M, σK/M values and σ_{abs}/M values have been calculated and tabulated respectively together with the isotopic cross sections (σ and σ_{abs}, respectively), for which references have been indicated. Notations: σ, isotopic cross section for the production of a radioactive nuclide due to thermal-neutron irradiation: σ_{abs}, isotopic cross section for thermal-neutron absorption; K, fractional abundance of a nuclide in a naturally occurring element; M, atomic weight of the element. (auth)

16487 ANALYSIS OF THE RESONANCE REACTIONS $^3H(d,n)^4He$ AND $^3He(d,p)^4He$ IN THE EFFECTIVE INTERACTION RADIUS APPROXIMATION. Barit, I. Ya.; Sergeev, V. A. Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 1-13(1971).

The energy dependence of the cross sections for the reactions $^3H(d,n)^4He$ and $^3He(d,p)^4He$ in the resonance region is analyzed in terms of effective range theory. Various types of indeterminacy which occur in the analysis of the reaction cross sections are discussed, and the results are compared with an analysis of experimental data interpreted with R-matrix theory. The extent to which the single-level approximation in the Humblet-Rosenfeld theory resembles the above methods for the description of resonance effects is examined. (1 figure, 4 tables) (R.W.R.)

16488 SHORT-RANGE NUCLEON–NUCLEON REPULSION AND LOW-ENERGY THREE-NUCLEON PARAMETERS. Kharchenko, V. F. (Inst. for Theoretical Physics, Kiev); Shadchin, S. A.; Storozhenko, S. A. Phys. Lett.; 37B: No. 2, 131-4 (15 Nov 1971).

It is shown by considering various potentials of a square form for the core repulsion and the attraction outside the core that low-energy three-nucleon parameters (binding energy of triton and n-d scattering lengths) are not sensitive to ways of introducing of the repulsion at short internucleon distances. (auth)

16489 SHELL MODEL ANALYSIS OF ELASTIC e^{-}–^{4}He SCATTERING. Frosch, R. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett.; 37B: No. 2, 140-2(15 Nov 1971).

A modified square well single particle potential is found to give as good a fit to the elastic e^{-}-^{4}He scattering data as the harmonic oscillator model with short range nucleon-nucleon correlations. (auth)

16490 D + d REACTIONS FROM 1.96 TO 6.20 MeV AND A STUDY OF THE STATES IN ^{28}Si EXCITED BY ^{24}Mg(α,α)^{24}Mg. Schulte, Robert Lawrence. Lexington, Ky.; Univ. of Kentucky (1971). 95p. University Microfilms Order No. 71-25,917.

Thesis

Two separate experiments have been performed: one on the D + d reactions and the other on the elastic scattering of α particles from ^{24}Mg. The absolute differential cross sections of the elastic scattering and the reaction products from the bombardment of deuterons by deuterons have been measured using gas targets. Angular distributions were measured at ten incident deuteron energies between 1.96 and 6.20 MeV in the lab system. The differential cross sections of the charged products have an absolute uncertainty of less than ±3% with the exception of the D(d,p)T reaction which has an uncertainty of less than ±3.5%. The D(d,n)^{3}He angular distributions were measured by the time-of-flight technique and normalized to the absolute neutron cross sections derived from the cross section measurements of the D(d,^{3}He)n reaction. The excitation function of ^{24}Mg(α,α)^{24}Mg elastic scattering was measured at four lab angles for incident α particle energies from 5.15 to 6.27 MeV. The target was of an enriched (>99.9%) separated isotope evaporated onto a thin carbon backing. A fit to the data was made using the Breit-Wigner single level formula in the E_{α} = 5.15 to 5.65 MeV range. Spins and parities were assigned to eight states of the compound nucleus, ^{28}Si, for excitation energies between 14.45 and 14.85 MeV. (Diss. Abstr. Int., B)

16491 K-MATRIX STUDY OF LIGHT NUCLEI SCATTERING. Bruno, Daniel Ruben Ovidio. Houston, Tex.; Rice Univ. (1971). 140p. University Microfilms Order No. 71-26,262.

Thesis.

A K-matrix model of scattering on light nuclei with A ≤ 4 is presented. Two-body and quasi two-body channels d-^{3}He, p–α, and b-^{3}He, b being the $^{1}S_{0}$ np pair are considered. An analysis of the spin observables is performed using the helicity formalism and the constraints of parity and time reversal invariance. The K-matrix input includes one-nucleon and deuteron exchange for d-^{3}He elastic and inelastic and for the p–α elastic phenomenological phase shifts are used. In addition, D wave resonances are included in the d-^{3}He elastic amplitudes, and the effect of these D wave resonances on the various polarizations serves to eliminate several possibilities compatible with the cross section data. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 15909, 16212, 16486, 16508, 16515, 16519, 16533, and 16755.

16492 LIFETIME OF THE FIRST EXCITED STATE OF ^{9}Li. Costa, G.; Beck, F. A.; Magnac-Valette, D. (CRN, Strasbourg, France). Nucl. Phys.; A181: No. 1, 174-6(1972).

Two different versions of the coincidence DSAM technique were used to measure the lifetime of the 981 keV state of ^{9}Li produced in the ^{9}Be(t,α)^{8}Li reaction. The mean lifetime of this state is τ_{m} = 14 ± 5 fs. This result is in good agreement with the theoretical predictions of Barker and also of Cohen and Kurath. (auth)

16493 POLARIZATION AND DIFFERENTIAL CROSS SECTION FOR NEUTRONS ELASTICALLY SCATTERED FROM ^{12}C. Drigo, L.; Manduchi, C.; Moschini, G.; (and others) (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Nucl. Phys.; A181: No. 1, 177-88(1972).

The polarization of the elastically scattered neutrons from ^{12}C in the energy range E = 1.9–5.2 MeV has been measured at laboratory angles from 25° to 155°. Differential cross sections were also obtained for 4.7 and 5.2 MeV neutron energies. The data have been corrected for multiple scattering and finite geometry. A phase-shift analysis of polarization and cross-section data has been performed at 1.9, 4.7 and 5.2 MeV. (auth)

16494 INELASTIC ELECTRON SCATTERING FROM ^{18}O. Groh, J. L. (Linear Accelerator Lab., Saskatoon, Saskatchewan); Singhal, R. P.; Caplan, H. S.; Dolbilkin, B. S. Can. J. Phys.; 49: No. 22, 2743-53(15 Nov 1971).

The inelastic electron scattering cross sections for the excitation of the levels in ^{18}O lying below 6.0 MeV were measured in the momentum transfer range 0.5 < q < 1.0 fm^{-1}. Excitation of the following T = 1 levels was observed: 1.98 MeV (2^{+}), 3.63 MeV (0^{+}), 3.92 MeV (2^{+}), 4.45 MeV (1^{-}), 5.09 MeV (3^{-}), 5.25 MeV (2^{+}), and 5.33 MeV (0^{+}). Estimates of transition probabilities to the ground state were made through a parameterization of the data using the generalized Helm model. Longitudinal form factors calculated from the wave functions of Benson and Irvine show excellent agreement with the experimental form factors. (auth)

16495 SPIN-FLIP PROBABILITY OF PROTONS INELASTICALLY SCATTERED FROM CARBON AND SULFUR. Wilson, Mark Alexander Dexter. Corvallis, Oreg.; Oregon State Univ. (1971). 110p. University Microfilms Order No. 71-25,338.

Thesis.

The spin-flip probability of protons inelastically scattered to the first 2^{+} excited states of ^{12}C and ^{32}S has been measured at proton energies of 15.93 MeV and 17.35 MeV for carbon and at 15.91 MeV and 17.57 MeV for sulfur. The (p,p'γ) coincidence technique was employed, with the γ detector axis along the perpendicular to the reaction plane. The measured angular distribution of the fraction of protons undergoing spin-flip during inelastic scattering from carbon displays a prominent peak of about 0.30 in magnitude at a proton angle of about 130°, which is in good agreement with previous measurements in the same proton energy region. The measured inelastic proton spin-flip probability on sulfur is higher than that reported for any other nucleus, exceeding a peak value of 0.5 at ϕ_{p} = 145° at E_{p} = 15.91 MeV. A collective DWBA analysis of the spin-flip probability, employing the full Thomas spin-orbit interaction, was carried out. The amplitude and position of the main experimental peak was reproduced in the case of protons on carbon, but the observed forward structure was not predicted. Attempts to fit the spin-flip probability of protons on sulfur at E_{p} = 17.57 MeV required an increase in the spin-orbit strength V_{SO} to 9.0 MeV, compared to the value of 6.2 MeV found by previous work to better fit the elastic polarization data. Efforts to fit the even larger value of the spin-flip probability observed at E_{p} = 15.91 MeV were even less successful since the DWBA analysis does not predict much variation with incident proton energy. (Diss. Abstr. Int., B)

16496 ELECTRON SCATTERING FROM ^{14}C. Kline, Francis J. Washington, D. C.; Catholic Univ. of America (1971). 113p. University Microfilms Order No. 71-29,238.

Thesis.

A series of low- and high-q^{2} experiments on ^{14}C were performed at the National Bureau of Standards 150-MeV Linac and the Stanford University 1.2-GeV Mark III accelerator. The main objective of these experiments was the determination of the q^{2} behavior of the elastic scattering form factor. These data were then fitted by both Born approximation and phase-shift analysis to obtain the parameters of two phenomenological ground-state charge distributions: the modified harmonic oscillator model and the Fermi model. These parameters then give the rms charge radius and surface thickness of the ^{14}C nucleus. They indicate that the rms charge radius of ^{14}C is larger than that of ^{12}C. These numbers for the modified harmonic oscillator model are as follows. ^{14}C: R_{rms} = 2.53 ± 0.5 fm; ^{12}C: R_{rms} = 2.43 ± .02 fm (both of these values were determined in this experiment). It has been determined that the rms charge radius of ^{13}C is smaller than that of ^{12}C, in contradiction to the $A^{\frac{1}{6}}$ law for the charge radius of nuclei. The present data, however, indicate that ^{14}C is larger than ^{12}C by an amount predicted by the $A^{\frac{1}{6}}$ law. Data on the inelastic structure of ^{14}C were also taken. Comments on the analog of the ground state of ^{14}B in ^{14}C, as well as the existence of a 15.1-MeV level in ^{14}C(as in ^{12}C and ^{13}C), are made. Data on the identification of some new levels are given. (Diss. Abstr. Int., B)

16497 QUALITATIVE DESCRIPTION OF THE SPECTRA ^{17}O AND ^{41}Ca. Bernstein, Aron M. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N. Y.); 69: No. 1, 19-41(Jan 1972).

The spectra of ^{17}O and ^{41}Ca are described by a weak-coupling model for the low-lying multiparticle–multihole states (up to five-particle–four-hole states are required). The energies of these states are obtained from the mass tables and the schematic particle–hole interaction of Bansal and French (configuration mixing is neglected). Overall approximate agreement is obtained

with the number and energies of states for each j^{π} and for the number and positions of the strong transitions observed in one- and two-nucleon-transfer-reaction experiments. The results of shell-model calculations can be qualitatively understood on the basis of this model. The limitations of the model and the need for more data to make detailed comparisons with theoretical models are discussed. (auth)

16498 NUCLEAR ROTATION IN HEAVY-ION SCATTERING. Seglie, Ernest; Inglis, D. R. (Univ. of Massachusetts, Amherst). Phys. Rev. Lett.; 28: No. 6, 371-2(7 Feb 1972).

The possibility is discussed that the observed energy dependence of the real part of the optical potential in $^{16}O-^{16}O$ elastic scattering arises from rotation of nuclei induced by their interaction. An estimate indicates that the effect may have the required magnitude. (auth)

16499 NEUTRON–NUCLEUS TOTAL CROSS SECTIONS FROM 900 TO 2600 MeV/c. Schimmerling, W. (Princeton-Pennsylvania Accelerator, N. J.); Devlin, T. J.; Johnson, W.; Vosburgh, K. G.; Mischke, R. E. Contract AT(30-1)-4159. Phys. Lett.; 37B: No. 2, 177-80(15 Nov 1971).

Neutron-nucleus total cross sections have been measured for 12 elements with an overall accuracy of ≈5%. Incident neutron momenta, determined by time of flight, were between 900 and 2600 MeV/c. The momentum and atomic weight dependence of the data have been parametrized in the form $\sigma_T = \sigma_0(P)A^{\beta}$ where $\beta = 0.75 \pm 0.02$. (auth)

16500 ALPHA-^{9}Be ASYMPTOTIC WAVE FUNCTION AS THREE-α PARTICLE SCATTERING. Osman, A. (Cairo Univ.). Phys. Lett.; 37B: No. 2, 135-9(15 Nov 1971).

The asymptotic form of the wave function for scattering from an initial state of α-particle incident on ^{9}Be, considered as two bound α-particles, with enough energy to give a final state of three free α-particles is given. The resulting equation with the obtained expression is suitable for numerical calculations. Applying this equation to the analysis of experimental data, very good agreement is obtained. (auth)

16501 INSTABILITY OF THE FOUR PARTICLE–FOUR HOLE SOLUTION OF ^{16}O AGAINST PARITY MIXING. Ananthanarayanan, K.; Das Gupta, S.; De Takacsy, N. (McGill Univ., Montreal). Phys. Lett.; 37B: No. 2, 143-4(15 Nov 1971).

It is shown that the usual four particle-four hole Hartree–Fock solution of ^{16}O in which no parity mixing is allowed in the single-particle orbitals, is unstable against parity mixing. The same result can be obtained from the α-cluster model. (auth)

16502 COMPARISON OF THE SPECTRA OF ^{18}O AND ^{18}F CALCULATED WITH WOODS–SAXON AND HARMONIC-OSCILLATOR WAVE FUNCTIONS. Pradhan, H. C. (Massachusetts Inst. of Tech., Cambridge); Shakin, C. M. Phys. Lett.; 37B: No. 2, 151-4(15 Nov 1971).

The low-lying levels of ^{18}O and ^{18}F were calculated using both harmonic-oscillator and Woods–Saxon wave functions. The effective interaction consisted of the bare G-matrix (G_B) for the Tabakin potential supplemented by the core-polarization correction (G_{3p1h}). (auth)

16503 OBSERVATION OF RESCATTERING EFFECTS IN THE REACTION ^{7}Li(d,nα)^{4}He. Sweeney, W. E. Jr.; Valkovic, V.; Rendic, D.; Phillips, G. C. (Rice Univ., Houston, Tex.). Phys. Lett.; 37B: No. 2, 183-5(15 Nov 1971).

The reaction ^{7}Li(d,nα)^{4}He was studied at incident deuteron energies of 2.07 and 2.09 MeV in an attempt to observe n-α rescattering effects. Contrary to previous results no peaks were observed which could be attributed to rescattering. (auth)

16504 PARTICLE–VIBRATION COUPLING AND THE GIANT DIPOLE RESONANCE IN ^{12}C. Baur, G.; Alder, K. (Univ., Basel). Helv. Phys. Acta; 44: No. 6, 703-7(1 Oct 1971).

The cross sections for the reactions $^{12}C(\gamma,p)$ and $^{12}C(\gamma,n)$ in the giant resonance region were calculated in a collective correlation model where the final nucleus may be in different excited states. The agreement with the rather incomplete experimental data is good. (auth)

16505 STATES IN NITROGEN-15 BETWEEN 12 AND 14 MeV EXCITATION ENERGY. Ramirez, Juan Jesus. Gainesville, Fla.; Univ. of Florida (1970). 126p. University Microfilms Order No. 71-24,967.

Thesis.

Measurements have been made of the cross sections for the $^{14}C(p,p)^{14}C$, $^{14}C(p,\alpha_0)^{11}B$, $^{14}C(p,n_0)^{14}N$, $^{14}C(p,n_1)^{14}N$, $^{14}C(p,\gamma)^{15}N$, and $^{11}B(\alpha,\alpha)^{11}B$ reactions as a function of energy. Several resonances were observed which show strong correlations between channels. Angular distributions of the cross sections for the $^{14}C(p,\alpha_0)^{11}B$, $^{14}C(p,n_0)^{14}N$, $^{14}C(p,n_1)^{14}N$, and $^{11}B(\alpha,\alpha)^{11}B$ reactions were also measured at several energies in the vicinity of the observed resonances. A Legendre polynomial analysis of the angular distributions provided possible spin assignments for the observed resonances. These results were used to guide a multi-level, multi-channel R-Matrix analysis of these resonances. The resonances at incident proton energies of 2.49 MeV, 2.913 MeV, 2.925 MeV, 3.375 MeV, 3.435 MeV, and 3.57 MeV were analyzed using the R-Matrix formalism. It was possible to obtain a set of level parameters for these resonances which accounted for the observed cross sections in all of the channels. The number of resonances included in the calculations, the coulomb-plus-hard-sphere background assumed for the elastic channels could not account for the observed cross sections off resonance. In the case of the elastic α-particle channel the difficulties could be explained, at least in part, by a large number of resonances which appear in the $^{11}B-(\alpha,p_0)^{14}C$ and $^{11}B(\alpha,n_0)^{14}N$ cross sections but which do not show strongly in the elastic α-particle cross section. An optical model fit to the 3.02 MeV angular distribution of the $^{11}B(\alpha,\alpha)^{11}B$ cross section was made to test the feasibility of describing the off resonance cross section at back angles with this kind of potential. The 2.49 MeV and 3.435 MeV levels have been identified as the isobaric analogs of the first and second excited states in ^{15}C. The resulting structure in ^{15}C is compared to existing calculations by Bhatt for the nine-nucleon system based on the Nilsson model. The $5/2^{+}$ state at 2.925 MeV is described in terms of an α-particle core-excited model. A comparison of this state is also made to the analog state in the mirror nucleus ^{15}O. (Diss. Abstr. Int., B)

16506 $^{9}Be(\alpha,n)^{12}C$ REACTION AND NEUTRON SCATTERING FROM ^{28}Si AND ^{32}S AT 9.8 MeV. Obst, Andrew Wesley. Lexington, Ky.; Univ. of Kentucky (1970). 132p. University Microfilms Order No. 71-25,911.

Thesis.

The 0° excitation functions for the $^{9}Be(\alpha,n)^{12}C$ reaction leading to the ground and first excited states in ^{12}C were measured between 1.69 and 6.44 MeV bombarding energy while those for the second and third excited state neutron groups were measured above 2.94 and 5.94 MeV bombarding energy, respectively. Angular distributions of the ground state and first two excited state neutron groups were measured at seventeen bombarding energies between 3.21 and 6.44 MeV, and for the third excited state neutron group they were measured at 6.24 and 6.44 MeV bombarding energy. The magnitude of the cross sections for the ground and first excited state neutron groups agrees well with the larger of the two sets of conflicting magnitudes reported in the literature. Double differential cross sections of the continuum of low energy neutrons were measured as a function of angle and neutron energy for ten bombarding energies ranging from 4.86 to 6.44 MeV. The features of the continuum are consistent with the sequential decay $^{9}Be + \alpha \rightarrow {}^{9}Be^{*} + \alpha' \rightarrow {}^{8}Be + n + \alpha'$, proceeding through the 1.67, 2.43, and 3.04 MeV excited states in ^{9}Be. The ratio of the populations of the first and second excited states in the $^{9}Be(\alpha,n)^{12}C$ reaction was determined at sixteen bombarding energies between 3.99 and 6.44 MeV. Elastic and inelastic differential cross sections for neutron scattering from ^{28}Si and ^{32}S have been measured at an incident neutron energy of 9.8 MeV, using the high energy neutron group from the $^{9}Be(\alpha,n)^{12}C$ source reaction. Due to the presence of the 4.439 MeV state group from the $^{9}Be(\alpha,n)^{12}C^{*}$ reaction only the scattering from the ground and first excited states in ^{28}Si and ^{32}S could be observed. Measurements were made on both nuclei by the time-of-flight technique in the angular region $20° \leq \theta_{lab} \leq 150°$ with an average energy spread of 600 keV. The measured yields were corrected for flux attenuation, angular resolution, and multiple scattering. The cross sections were fitted by incoherently adding a compound nuclear contribution to a direct reaction contribution calculated by the optical model plus DWBA method and also by the coupled-channel method. Collective model fits to ^{32}S using oblate and prolate deformed rotational model and vibrational model form factors were all equally good. The fits to ^{28}Si are not as good, probably due to the large fluctuations in the total and partial cross sections for ^{28}Si in this energy region. (Diss. Abstr. Int., B)

16507 NEUTRON SCATTERING BY ^{12}C IN A UNIFIED THEORY FORMALISM. Leung, Ted Tit-Hung. Athens, Ohio; Ohio Univ. (1971). 199p. University Microfilms Order No. 71-29,533.

Thesis.

A unified theory which will simultaneously describe nuclear structure and nuclear reactions including the bound states in the former and the elastic and inelastic scatterings in the latter case is developed. This derivation is followed by a realistic calculation featuring the carbon-12 and neutron interaction system, either where carbon-12 is a target nucleus scattering the neutron beam or acts as a core nucleus binding the extra neutron. This

formalism begins with the designation of an expression for the open channel projection operator. Following a procedure similar to Feshbach's unified reaction theory, the infinite coupled channel Schroedinger equations are block divided into two groups by the projection operators. Upon decoupling, one obtains a two-potential open channel equation which is responsible for the reaction mechanisms such as direct reactions and compound resonances. One also obtains a two-potential closed channel equation which is responsible for the level structure such as the bound states and the quasi-bound states. The reaction dynamics are discussed in terms of the collision matrix, the reactance matrix and the transition matrix. Utilizing the symmetry relations, simple expressions for the differential cross section and polarization are derived. For the carbon-12 and neutron interaction system, the following quantities were calculated: total cross sections, phase shifts, resonance level widths, angular distributions and Legendre coefficients, polarization and associated Legendre coefficients, and finally, the carbon-13 spectrum including both normal and nonnormal parity states from the ground state up to the carbon-12 neutron inelastic threshold. The results indicate that the carbon nucleus can be described as a deformed nucleus with $\beta = .143$. The calculation as a whole has proved that the theory is valid for studies of light nuclei. A theoretical relation between reaction and structure is thus established with the present expression of the projection operator. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 16486, 16490, 16495, 16499, 16506, 16518, 16519, 16533, and 17109.

16508 (FRNC-TH-116) THE β^+ DECAY AND GAMOW-TELLER TRANSITIONS OF THE A = 4n + 2 NUCLEI ^{18}Ne, ^{38}Ca, AND ^{42}Ti. Aslanides, Elie (Strasbourg Univ. (France). Faculte des Sciences). 1970. 159p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The β^+ decay of A = 4n + 2 nuclei was studied. The half-life of ^{18}Ne was determined, a new allowed transition was established, and the Gamow-Teller (GT) matrix elements for ^{18}Ne transitions to the two 1^+ lower levels of ^{18}F were derived. The study of the β^+ decay of ^{38}Ca and ^{42}Ti into ^{38}K and ^{42}Sc, respectively, enabled the decay scheme and the corresponding transition matrix elements to be established. The log-ft values and the GT transition matrix elements were compared to theoretical predictions in the framework of independent-particle models and models enabling the mixing of two-particle states and 4-particle-2-hole deformed states. Results concerning analog M1 transitions with $\Delta T = 1$ were also derived from the GT transitions (^{18}C, ^{20}F, ^{38}K, and ^{41}Ar). The mean lives of the levels, corresponding to strong β^+ transitions, are in agreement with the isobaric spin selection rules for self-conjugate nuclei. The weak GT transitions correspond to strongly deformed, 1^+ final states. (France)

16509 (KFK-1352) MEASUREMENT OF THE NUCLEAR MAGNETIC MOMENTS OF SHORT-LIVED RADIONUCLIDES. EXAMPLE: 408-msec ^{29}Na. Schweickert, H. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium). May 1971. 61p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis.

The spin and magnetic moment of 408-msec ^{29}Na, the mirror nucleus to ^{29}F, were measured. ^{29}Na was produced in a gas target by the ^{26}Ne(d,2n)^{29}Na reaction and polarized by spin-exchange scattering with optically pumped ^{87}Rb. An asymmetry of 3% in the β decay of the polarized nuclei was found, which served to detect r-f transitions between hfs levels of the atomic ground state of ^{29}Na. $\Delta F = 0$ and $\Delta F = 1$ resonances were recorded yielding $I(^{29}Na) = 2$ and $\mu_I(^{29}Na) = 0.369(3)$ nm. All experimental details including the coupling to an on-line computer are described. The extension of the method to other short-lived isotopes is discussed. A comparison of the results with various theoretical estimates is given. (auth)

16510 INVESTIGATION OF THE ^{32}S(p,γ)^{33}Cl REACTION. Alexander, Larry Alan. Lawrence, Kans.; Univ. of Kansas (1971). 128). University Microfilms Order No. 71-27,115.

Thesis.

The properties of a number of the excited states, both bound and unbound, of ^{33}Cl have been experimentally measured by the ^{32}S(p,γ)^{33}Cl reaction. The proton energy range investigated was from 1755 keV to 2917 keV. Lifetime, double correlation, and triple correlation measurements were performed in order to uniquely determine the spin and/or parity of several of the excited states of ^{33}Cl. Decay schemes were determined and comparisons were made between the experimentally determined multipole transition strengths and previously measured multipole transition strengths. The results of the analysis of the correlation data indicate that the spins of the 1985-keV, 2974-keV, 4114-keV, 4746-keV, and 4823-keV excited states are uniquely $5/2$, $7/2$, $3/2$, $5/2$, and $3/2$, respectively. The excited states at 4439 keV and at 4465 keV were determined to have a spin and parity assignment of $3/2^+$. The analysis also resulted in a restriction of the spin and parity of the 3981-keV state to $3/2^+$ or $5/2^+$ and of the 5092-keV state to $5/2$ or $7/2$. The analysis of the correlation data for the 2347-keV state resulted in an assignment of $(3/2, 5/2)^+$, with $3/2^+$ strongly favored. A combination of the results of the lifetime measurement and of the correlation measurements uniquely determine the spin and parity of the 1985-keV and 1974-keV states to be $5/2^+$ and $7/2^+$, respectively. The new Q-value, determined from the present data, is 2277.6 ± 3.4 keV. (Diss. Abstr. Int., B)

16511 SPIN OF THE 4.057 MeV LEVEL IN ^{25}Mg. Kean, D. C.; Ollerhead, R. W. (Univ. of Guelph, Ont.). Can. J. Phys.: 49: No. 22, 2793-6(15 Nov 1971).

A gamma-ray polarization measurement has shown that the 4.057-MeV level of ^{25}Mg has spin-parity $J^\pi = 9/2^+$ in agreement with previous speculations regarding the structure of this state. This experiment illustrates that in selected cases a single-crystal Ge(Li) polarimeter is capable of giving useful polarization information for gamma-ray energies as high as 4 MeV. (auth)

16512 MEASUREMENT OF THE MEAN LIVES AND MIXING COEFFICIENTS IN ^{27}Mg. Costa, G.; Beck, F. A. (CRN, Strasbourg). Nucl. Phys.; A181: No. 1, 132-44(1972). (In French).

The mean lives of the lowest seven excited states of ^{27}Mg were measured in the ^{26}Mg(d,pγ) reaction with two different versions of the Doppler-shift attenuation method. Mean lives of $\tau_m = 1.4 \pm 0.3$, 1.15 ± 0.20, 0.80 ± 0.16, 0.10 ± 0.05, <0.08, < 0.075 and 0.64 ± 0.15 ps were found for the levels at $E_x = 984$, 1698, 1940, 3109, 3476, 3558 and 3762 keV, respectively. Gamma-ray angular distribution and γ-γ angular correlation measurements lead to the following mixing ratios: $\delta(1940 \rightarrow 984 \text{ keV}) = -0.05 \pm 0.04$ and $\delta(984 \rightarrow 0 \text{ keV}) = -0.22 \pm 0.02$. The deduced transition strengths are discussed in the framework of the Nilsson model. (auth)

16513 STUDY OF THE ^{35}Cl(^{3}He,p)^{37}Ar REACTION. Hubert, B.; Nann, H.; Schaefer, W.; Bass, R. (Univ., Frankfurt am Main). Nucl. Phys.; A181: No. 1, 1-10(1972).

Angular distributions of protons from the ^{35}Cl(^{3}He,p)^{37}Ar reaction have been measured at bombarding energies between 9 and 14 MeV. The 14-MeV data are compared with DWBA calculations based on various sets of shell-model wave functions. (auth)

16514 LOW LYING EXCITED STATES OF THE ^{37}Ar NUCLEUS. Champlin, Jeffrey William. New Haven; Yale Univ. (1971). 127p. University Microfilms Order No. 71-28,148.

Thesis.

The structure of the low-lying excited states of the ^{37}Ar nucleus was investigated by studying gamma rays and protons from the reaction ^{36}Ar (d,pγ) ^{37}Ar using an enriched (>98% ^{36}Ar) gas target. Gamma-ray measurements using Ge(Li) detectors determined the energies of the first eleven excited states ($E_x < 3.7$ MeV). Observation of the Doppler shift in the gamma-ray energy allowed an upper limit of $\tau \leq 40$ picoseconds to be placed on the lifetimes of all but three states. Proton-gamma-ray coincidence measurements using colinear geometry were made at three bombarding energies: $E_d = 2.800$, 2.975, and 3.100 MeV. Angular correlations derived from these measurements gave spin values and information about the electromagnetic properties of the states. Spin and parity assignments were also investigated by measuring proton angular distributions with $E_d = 18.0$ MeV and comparing the results with DWBA calculations. These measurements gave the following values for (E_x; J^π): (1408.8 ± 1.5; $1/2^+$), (1611.2 ± 0.8; $1/2^-$, $1/2^-$), (2218.2 ± 1.5; $5/2$, $7/2$), (2490.6 ± 1.3; $3/2^-$), (2796.3 ± 1.8; $3/2^+$, $5/2^+$), (3171.3 ± 1.7; $3/2$, $5/2$), (3186.4 ± 1.7), (3273.4 ± 1.6; $3/2$, $5/2$), (3516.1 ± 1.8; $3/2^-$), (3526.1 ± 2.1; $7/2$), and (3607.7 ± 2.6; $3/2$, $5/2$). The results are compared with those for the mirror nucleus, ^{37}K, and with shell-model calculations of the mass-37 system. (Diss. Abstr. Int., B)

16515 STATIC QUADRUPOLE MOMENTS AND B(E2) VALUES IN sd-SHELL NUCLEI. Gunye, M. R. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 37B: No. 2, 125-7(15 Nov 1971).

The static electric quadrupole moments, magnetic dipole moments and the reduced transition probabilities for E2 transitions in some sd-shell nuclei are calculated from the projected multi-shell Hartree-Fock wave functions. The overall agreement between the calculated and experimental results is quite good. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 16486, 16497, 16499, 16508, and 16533.

16516 ODD Co ISOTOPES IN A UNIFIED VIBRATIONAL MODEL. Stewart, K. W. C. (Queen's Univ., Kingston, Can. Univ. of Manchester, Eng.); Castel, B.; Singh, B. P. Phys. Rev., C; 4: No. 6, 2131-43(Dec 1971).

The odd-A Co isotopes are studied in a version of the unified vibrational model which incorporates both anharmonic and quasiparticle effects. With the $p_{\frac{3}{2}}$, $p_{\frac{1}{2}}$, $f_{\frac{5}{2}}$, and $f_{\frac{7}{2}}$ orbitals available, quasihole states are coupled to anharmonic vibrations of the corresponding Ni cores. Very good agreement is obtained with the known properties of $^{57-59}$Co in a one-parameter fit, while the $^{61-63}$Co calculations are essentially parameter free. The systematics of the energy levels of $^{57-63}$Co can also be explained well by the model. (auth)

16517 QUADRUPOLE MOMENT OF THE LOWEST ROTATIONAL BAND IN EVEN CALCIUM NUCLEI. Towsley, C. W.; Cline, D.; Horoshko, R. N. (Univ. of Rochester, N. Y.). Phys. Rev. Lett.; 28: No. 6, 368-71(7 Feb 1972).

The static electric quadrupole moment of the 2_1^+ state in ^{42}Ca was measured to be $(-18.9 \pm 8.1)e$ fm^2. A $B(E2; 2_1^+ \rightarrow 0_1^+) = (81.5 \pm 3.0)e^2$ fm^4 was obtained. The E2 properties of the lowest seven levels were used to decompose the levels into $(fp)^2$ states plus a deformed band with $\beta_2 = +0.375 \pm 0.006$. The band structure, moments of inertia, and β_2 values in ^{42}Ca and ^{40}Ca are nearly identical, this fact implying that the lowest $K = 0^+$ band in ^{40}Ca is also prolate. (auth)

16518 INVESTIGATION OF HIGHER ORDER EFFECTS FROM SOME HINDERED-ALLOWED BETA DECAYS. Singhal, Rajendra Prasad. Pullman, Wash.; Washington State Univ. (1971). 99p. University Microfilms Order No. 71-28,797.

Thesis.

The higher-order effects in hindered-allowed beta decays of ^{182}Ta, ^{22}Na, ^{56}Mn, ^{56}Co, ^{58}Co, and ^{32}P were analyzed utilizing all the available data on the spectrum shape, beta–gamma directional correlation, beta–gamma (circularly polarized) correlation, and beta longitudinal polarization. Exact electron radial functions which take into account finite nuclear size and deBroglie wavelength effects were used. It was found that the anomalous shape factor and the values of beta–gamma correlations observed in all of the above hindered-allowed beta decays can be explained within the framework of the (Vector–Axial Vector) law of weak interactions, by assuming small values ($\approx \pm 0.05$) for the higher-order matrix-element ratios $U = M((\underline{\sigma} \cdot \underline{r})\underline{r})/M(\underline{\sigma})$, $V = (i\gamma_5 \underline{r})/M(\underline{\sigma})$, and $W = M(\underline{\sigma} \times \underline{r})/M(\underline{\sigma})$. However, theoretical attempts to explain the empirical values of the higher-order matrix elements by assuming single-particle nuclear states were not very successful. Single-particle estimates were about an order of magnitude too small in almost all cases. The empirical values of the higher-order matrix elements V and W were also compared with the predictions of the nonrelativistic, Conserved Vector Current (CVC), and Partially Conserved Axial Vector Current (PCAVC) theories. Generally speaking, agreement was obtained with the nonrelativistic and CVC predictions, but disagreement was obtained with the PCAVC prediction. Finally, for the decays of ^{56}Co and ^{58}Co, a new value of the Fermi matrix element was obtained which took account of the higher-order matrix elements. It was found that the inclusion of higher-order matrix elements did not significantly change the value of the Fermi matrix element. The implication of this result for the charge independence of nuclear forces is discussed. (Diss. Abstr. Int., B)

16519 CORRECTIONS TO THE ft-VALUES OF $0^+ \rightarrow 0^+$ SUPERALLOWED β-TRANSITIONS AND EFFECTIVE CONSTANT G'_V OF NUCLEAR β-DECAY. Fayans, S. A. (Inst. of Atomic Energy, Moscow). Phys. Lett.; 37B: No. 2, 155-8(15 Nov 1971).

The second forbidden and isospin violation corrections to superallowed β-decays are calculated. Effective constants G'_V obtained with the aid of "outer" part of radiative corrections are in good agreement with each other for all nuclei involved, while that for ^{34}Cl proves somewhat lower. (auth)

16520 NUCLEAR EXCITATION OF GIANT DIPOLE AND QUADRUPOLE RESONANCES. Bang, J.; Kunz, P. D. (Univ. of Copenhagen). Phys. Lett.; 37B: No. 2, 128-30(15 Nov 1971).

Cross sections for nuclear excitation of giant dipole and quadrupole resonances are calculated in DWBA, using a macroscopic form factor. Agreement with existing data is obtained. The dependence of the matrix elements on mass number is exposed, leading to a prediction of comparatively small cross sections for heavier nuclei. (auth)

16521 ENERGY LEVELS IN ^{48}Cr OBSERVED IN THE ^{50}Cr(p,t)^{48}Cr REACTION. Dorenbusch, W. E. (Wayne State Univ., Detroit); Ball, J. B.; Auble, R. L.; Rapaport, J.; Belote, T. A. Contract AT(30-1)-2098. Phys. Lett.; 37B: No. 2, 173-6(15 Nov 1971).

Energy levels of ^{48}Cr have been studied with the ^{50}Cr(p,t)^{48}Cr reaction at 51 MeV. Spin and parity assignments have been made for levels below 9 MeV of excitation. The ground-state Q value is 15,100 ± 8 keV. Levels at 5.79 and 6.10 MeV have been identified as the T = 1 analogs of the ground and first-excited states in ^{48}V, respectively. A doublet is observed at 8.75 MeV near the energy expected for the T = 2 analog of the ^{48}Ti ground state. (auth)

16522 DETERMINATION OF THE NUCLEAR MAGNETIC MOMENTS ON FREE ^{43}Ca-, ^{87}Sr-, ^{135}Ba-, ^{137}Ba-, ^{171}Yb-, AND ^{173}Yb-ATOMS BY MEANS OF OPTICAL PUMPING. Olschewski, L. (Univ., Heidelberg). Z. Phys.; 249: No. 3, 205-27(1972). (In German).

The optical pumping method was successfully used (Z. Phys., 196: 77(1966) and 200: 224(1967)) to determine the nuclear magnetic moments of ^{135}Ba, ^{137}Ba, ^{171}Yb and ^{173}Yb. This method has now been extended to ^{43}Ca and ^{87}Sr. The nuclear moments of the Ba and Yb isotopes were remeasured by means of an improved experimental technique. Especially, the influence of the light shift was investigated, and the nuclear moments were corrected by eliminating this shift. The magnetic field was calibrated by means of optical pumping of ^{23}Na. The nuclear magnetic moments obtained from the rf transitions between the Zeeman levels of the ground state $^1S_0$ are: $\mu(^{43}\text{Ca}) = -1.3172\ (6)\ \mu_N$; $\mu(^{87}\text{Sr}) = -1.0924\ (7)\ \mu_N$; $\mu(^{135}\text{Ba}) = 0.83656\ (2)\ \mu_N$; $\mu(^{137}\text{Ba}) = 0.93582\ (2)\ \mu_N$; $\mu(^{171}\text{Yb}) = 0.491889\ (8)\ \mu_N$ and $\mu(^{173}\text{Yb}) = -0.67744\ (3)\ \mu_N$ (diamagnetic correction was applied). The ratios of the nuclear moments of the elements with two odd isotopes are: $\mu(^{137}\text{Ba})/\mu(^{135}\text{Ba}) = 1.11865\ (3)$; $\mu(^{173}\text{Yb})/\mu(^{171}\text{Yb}) = -1.37723\ (7)$. In comparison with the results of nuclear induction, the chemical shifts were calculated to be: $\delta(\text{Ca}) \leq \pm 5 \cdot 10^{-4}$; $\delta(\text{Sr}) = -6\ (7) \cdot 10^{-4}$; $\delta(\text{Ba}) = -7.8\ (4) \cdot 10^{-4}$ and $\delta(\text{Yb}) = -23\ (10) \cdot 10^{-4}$. (auth)

16523 PHENOMENOLOGICAL EFFECTIVE TWO-BODY INTERACTION FOR CALCIUM ISOTOPES. Banerjee, D.; Richert, J. (CRN, Strasbourg). Lett. Nuovo Cim.; 3: No. 1, 30-4(1 Jan 1972).

An effective two-body interaction is considered which consists of the usual pairing force and a long-range part of tensor character acting at the nuclear surface only. Results of calculations of T = 1, two-body matrix elements for this effective interaction (PSTI), the surface delta interaction (SDI), and the modified SDI are given. It is concluded that PSTI gives a good approximation for the residual two-body interactions of identical extra-core nucleons. (3 tables). (R.W.R.)

16524 ELECTROMAGNETIC TRANSITIONS IN $(1f_{\frac{7}{2}})^{\pm 3}$ NUCLEI. MEAN LIVES OF THE LOW-LYING LEVELS OF ^{53}Mn. Brandolini, F. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua); Brusegan, A.; Signorini, C.; Ricci, R. A. Nuovo Cim.; 7A: No. 1, 144-52(1 Jan 1972).

The mean lives of three low-lying levels of ^{53}Mn at excitation energies of 1.29 MeV ($\frac{3}{2}^-$), 1.44 MeV ($\frac{11}{2}^-$), and 1.62 MeV ($\frac{9}{2}^-$) were measured using the Doppler-shift-attenuation method with p–γ coincidences in the ^{50}Cr(α,pγ)^{53}Mn reaction. The following values were obtained for the three levels, respectively: $\tau_m = (0.87 \pm 0.22)$, (1.15 ± 0.38), and $(0.56 - 0.15)$ ps. Branching and multipole mixing ratios in agreement with other recent experimental data were also obtained. M1 transitions between states assumed to belong to the basic $(\pi f_{\frac{7}{2}})^{-3}$ multiplet are retarded by factors ranging between 50 to 100, while E2 transitions are enhanced by factors of the order of 10. This agreement with the behavior of ^{51}V (with $(1f_{\frac{7}{2}})^3$ configuration) supports the basic shell-model features of nuclei with a ^{48}Ca core. (auth)

16525 ELASTIC SCATTERING OF PROTONS FROM CHROMIUM. Wylie, W. R.; Zamboni, F.; Zych, W. (Univ., Zurich). Helv. Phys. Acta; 44: No. 6, 757-62(1 Oct 1971).

Elastic scattering of protons by chromium was measured in the energy range 2.4 to 4.1 MeV. Only one of many strong resonances is attributed to an analog state to an excited level with $J^\pi = \frac{3}{2}^-$ at $E_x = 2.321$ MeV in ^{53}Cr. The Coulomb energy displacement is given as $\Delta E_c = (8.354 \pm 0.005)$ MeV. (auth)

16526 OBSERVATION OF POLARIZATION TRANSFER IN THE REACTION ^{56}Fe(d,p)^{57}Fe USING THE MOESSBAUER EFFECT. Griffith, J. A. R.; Isaak, G. R.; Roman, S. (Univ. of Birmingham, Eng.). Phys. Rev. Lett.; 28: No. 6, 375-8(7 Feb 1972).

Transfer of polarization to the residual nucleus in a nuclear reaction was observed by combining the use of a vector-polarized deuteron beam with Moessbauer measurements of magnetic sub-

level populations. A large transfer of polarization was seen in the reaction $^{56}Fe(d,p)^{57}Fe^*$ terminating in the 14.4-keV state of ^{57}Fe, consistent with a simple polarization-transfer mechanism. The method is applicable to a number of reactions leading to Moessbauer final states. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 15311, 16212, 16522, 16533, and 16558.

16527 14.8 MeV NEUTRON CROSS SECTIONS FOR ENRICHED ISOTOPES OF ^{82}Se, ^{92}Mo, ^{117}Sn, ^{128}Te, AND ^{130}Te. Hasan, S. S.; Prasad, R.; Seghal, M. L. (Aligarh Muslim Univ., India). Nucl. Phys.; A181: No. 1, 101-5(1972).

The (n,2n), (n,p), and (n,α) cross sections have been measured for the enriched isotopes of ^{82}Se, ^{92}Mo, ^{117}Sn, ^{128}Te and ^{130}Te using the activation technique. The experimental values of the cross sections have been compared with the predictions of statistical theory. (auth)

16528 STUDY OF THE COLLECTIVE STATES IN ^{88}Sr AND ^{89}Y BY INELASTIC ELECTRON SCATTERING. Fivozinsky, Sherman Paul. Storrs, Conn.; Univ. of Connecticut (1971). 139p. University Microfilms Order No. 71-29,868.

Thesis.

Inelastic cross sections of low-lying levels and elastic cross sections have been measured in ^{88}Sr and ^{89}Y by electron scattering using the NBS Linac and electron scattering facility. Incident electron energies were varied between 40 and 120 MeV corresponding to a momentum transfer range of 0.4 to 1.0fm^{-1}. Data was accumulated at two scattering angles, 110.5 and 128.2 degrees. This investigation was undertaken to gather information on the applicability of the weak coupling core excitation model to low-lying states in ^{89}Y. This model predicts two levels in ^{89}Y for each "core" state in ^{88}Sr. In addition, the sum of the transition strengths of the pair should equal the strength of the core state. The appearance of two quadrupole transitions (whose summed strengths were far below that of the quadrupole transition in ^{88}Sr) and three octupole transitions led us to investigate these levels in a momentum transfer region which is sensitive to the structure of the excited states. Form factors $(\sigma/\sigma_{Rutherford})$ for the 1.51, 1.74, 2.21, 2.52, 2.86, and 3.1 MeV levels in ^{89}Y, and the 1.84, and 2.74 MeV levels in ^{88}Sr are presented. The form factor of the level at 2.86 MeV in ^{89}Y was found to exhibit a significantly different momentum transfer dependence than the other two octupole states at 2.21 and 2.52 MeV. The 2.21 and 2.52 MeV states, however, have the same momentum transfer dependence as the core state in ^{88}Sr at 2.74 MeV, thus lending credence to their description as weak coupling states. The two quadrupole excitations in ^{89}Y at 1.51 and 1.74 MeV have form factors which are dropping faster with increasing momentum transfer than the core state in ^{88}Sr at 1.84 MeV. This suggests that the ^{89}Y 2^+ states have a larger transition radius than the core state. Thus they have a different excited state structure than the core state which may be due to the blocking effect of the extra proton in ^{89}Y. A simple configuration mixing model has been applied to the octupole states in ^{89}Y which predicts the presence and strength of the extra octupole state at 2.86 MeV in ^{89}Y. The measured elastic form factors for both nuclei have been fitted with a Fermi charge distribution. The best fit values of the charge density parameters exhibit anomalously small thickness parameters which may be due to dispersion effects. (Diss. Abstr. Int., B)

16529 M1 TRANSITIONS FROM $g_{\frac{9}{2}}$ ANALOG-TO-ANTIANALOG STATES IN THE NUCLEI ^{59}Cu, ^{61}Cu, ^{63}Cu, ^{65}Ga, AND ^{67}Ga. Szentpetery, I.; Szuecs, Judit (Central Research Inst. for Physics, Budapest). Phys. Rev. Lett.; 28: No. 6, 378-81(7 Feb 1972).

$g_{\frac{9}{2}}$ analog resonances were found in the reactions $^{58,60,62}Ni(p,\gamma)^{59,61,63}Cu$ and $^{64,66}Zn(p,\gamma)^{65,67}Ga$ with strong M1 transitions to the corresponding antianalog states. (auth)

16530 SPECTROSCOPY OF SOME LOW-LYING STATES IN ^{69}Zn. Steiner, William Samuel. Columbus, Ohio; Ohio State Univ. (1971). 141p. University Microfilms Order No. 71-27,568.

Thesis.

Analog resonance reactions of ^{68}Zn + p were investigated. Excitation functions for elastic and inelastic protons (0^+, ground state; 2^+, 1.08 MeV; 0^+, 1.66 MeV; 2^+, 1.88 MeV) from 4 to 6 MeV excitation energy were measured at 90°, 120°, 130° and 160°. The analog resonances of some low-lying states of ^{69}Zn were investigated using the triple angular correlation geometry of Goldfarb and Seyler for the $^{68}Zn(p,p'_1\gamma)$-$^{69}Zn^*$(1.08 MeV) reaction. The following spin and parity assignments were made for the states in ^{69}Zn: (energy in MeV) 0.835, $3/2^-$; 1.634, $5/2^+$; 1.696, $1/2^+$; 2.262, $1/2^+$; 2.403, $5/2^+$; 2.554, $5/2^+$; and 2.669, $1/2^+$. (Diss. Abstr. Int., B)

16531 ISOBARIC ANALOGUE RESONANCE IN ^{66}Zn. Das, J. M. (Centre de Physique Nucleaire, Heverlee, Belg.); Meulders, J. P.; Deconninck, G. Ann. Soc. Sci. Brux. Ser. I; 85: No. 2, 172-80(25 Aug 1971).

Isobaric analog resonances can be used to study the low-lying levels of the parent nucleus by observing the particle emission and/or gamma transition following particle emission. This method was used to study the resonance at E_p = 2.959 MeV, corresponding to the 0.462-MeV level of ^{66}Cu, by means of the $^{65}Cu(p,n)$ and $^{65}Cu(pn,\gamma)$ reactions. Angular distributions and excitation functions for the reactions are given. The spin and parity of the 0.462-MeV level of ^{66}Cu and the low-lying levels of ^{65}Zn were confirmed. (3 figures, 1 table) (R.W.R.)

16532 STUDIES IN NUCLEAR SPECTROSCOPY. McDonnell, Michael Dennis. New York; Fordham Univ. (1971). 102p. University Microfilms Order No. 71-26,982.

Thesis.

The inner bremsstrahlung (IB) spectrum accompanying the electron capture to the 514 keV level in ^{85}Rb was studied. A fast-slow coincidence timing circuit was used, employing a thin crystal (1/8 in.) NaI detector to register the succeeding Rb K x ray and a thick crystal (1¾ in. × 2 in.) NaI detector to record the IB spectrum in coincidence with the 15 keV x ray. Analysis of the IB spectrum yields an end point energy of 471 ± 30 keV which, when added to the energy of the 514 keV level and the 15 keV binding energy of the Rb K-shell electron, gives a decay energy of 1000 ± 30 keV for the $^{85}Sr \rightarrow {}^{85}Rb$ decay. The angular correlation between the K x ray and the succeeding 303 and 356 keV γ rays of ^{133}Cs in the decay of ^{133}Ba has been measured using an angular correlation setup with two thick crystal (1¾ in. × 2 in.) detectors and a fast coincidence unit. An anisotropy of A = 0.005 ± 0.006 was obtained in agreement with existing theory and in contrast with the small but positive result obtained by Perepelkin in his study of ^{54}Mn. An accurate determination of the half-life of the isomeric state of ^{113m}In has been carried out by following the decay of the 393 keV γ ray transition from the metastable state using a thick crystal (1¾ in. × 2 in.) NaI detector in a single channel system. A measure of the nuclear matrix element for the transition has been calculated using the value of 99.2 ± 0.6 min and is compared with measurements for similar transitions. Finally, the decay scheme of the $^{68}Ge \rightarrow {}^{68}Ga \rightarrow {}^{68}Zn$ system was studied with high resolution (2.5 keV at 511 keV) Ge(Li) detectors. A previously unreported 578 keV γ ray was seen both in the singles spectrum and in coincidence with the 1.07 MeV γ ray which goes to the ground state. This confirms the existence of a 1.66 MeV level in ^{68}Zn which had previously been observed only in reaction experiments. The computed log ft for the transition from ^{68}Ga to the 1.66 MeV level of ^{68}Zn is 6.0 ± 0.4 which compares favorably with the log ft for other allowed transitions in the ^{68}Ga decay. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 15312, 15632, 16499, 16522, 16527, 16532, and 16559.

16533 (COO-1265-116) ANNUAL REPORT, 1971. (Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics). Aug 1971. Contract AT(11-1)-1265. 216p. Dep. NTIS.

ALUMINUM-27—deuteron inelastic scattering at 20 MeV, angular distributions for, (E)
—deuteron reactions (d,He-3) at 20 MeV, DWBA analysis of, (E)
—energy levels of, calculation using coriolis bandmixing model, (T)
BISMUTH-209—alpha elastic scattering at 22 MeV optical-model analysis of, (E/T)
—alpha reactions at 22 MeV, optical-model analysis of, (E/T)
CADMIUM-114—proton elastic and inelastic scattering at 18.6 MeV, angular distributions for, (E)
CALCIUM-40—alpha reactions (α,d) at 25.5 MeV angular distributions for, (E)
CARBON-14—proton reactions (p,t) at 39.8 MeV, finite-range DWBA analysis of, (T)
COPPER-65—alpha elastic scattering at 26 to 27.5 MeV, optical-model analysis of, (E/T)
FLUORINE-19—alpha elastic and inelastic scattering at 25 MeV, angular distributions for, (E)

—helium-3 reactions (He-3,t) at 25 MeV, angular distributions for, (E)
HELIUM-4—proton reactions with, resonating-group calculations using imaginary potential, (T)
LEAD-208—alpha inelastic scattering at 65 MeV with nucleon emission, DWIA analysis of, (T)
—proton reactions (p,t) at 40 MeV, finite-range DWBA calculations for, (T)
MAGNESIUM-24—helium-3 inelastic scattering at 25 MeV, angular distributions for, (E)
NICKEL-58—helium-3 elastic scattering at 27 and 29.5 MeV, analysis using reformulated optical model, (E/T)
—alpha elastic scattering at 28 and 29.5 MeV, angular distributions for, (E)
OXYGEN-17—helium-3 reactions (He-3,d) at 25 MeV, differential cross section for, (E)
PHOSPHORUS-29—energy levels from silicon-28 (He-3,d) reactions, spectroscopic factors for, (E)
PHOSPHORUS-30—energy levels from silicon-29 (He-3,d) reactions, spectroscopic factors for, (E)
PHOSPHORUS-31—energy levels from silicon-30 (He-3,d) reactions, spectroscopic factors for, (E)
SCANDIUM-42—energy levels from calcium-40 (α,d) reactions, (E)
SCANDIUM-44—energy levels from calcium-44 (He-3,t) reactions, spin-parity assignments for, (E)
SCANDIUM-45—alpha elastic scattering at 26 to 27.5 MeV, optical-model analysis of, (E/T)
SILICON-28—helium-3 inelastic scattering at 23.5 to 26.5 MeV, angular distribution and excitation functions for, (E)
SULFUR-32—sulfur-32 elastic scattering at 85.5 to 95 MeV, energy spectra from, (E)
TELLURIUM-123—energy levels from tellurium-125 (p,t) reactions, (E)
TELLURIUM-124—energy levels from tellurium-125 (p,d) reactions, (E)
TELLURIUM-125—proton reactions (p,t) at 17 MeV, angular distributions for, (E)
TELLURIUM-126—energy levels from tellurium-128 (p,t) reactions, (E)
TELLURIUM-128—energy levels from tellurium-130 (p,t) reactions, (E)
—proton reactions (p,t) at 17 MeV, angular distributions for, (E)
TELLURIUM-130—proton reactions (p,t) at 17 MeV, angular distributions for, (E)
TIN-122—alpha elastic scattering at 26 to 27.5 MeV, optical-model analysis of, (E/T)
TITANIUM-48—helium-3 elastic scattering at 27 and 29.5 MeV, analysis using reformulated optical model, (E/T)
TITANIUM-49—helium-3 reactions (He-3,d) at 22 MeV, deuteron spectra from, (E)
VANADIUM-50—energy levels from titanium-49 (He-3,d) reactions, (E)
YTTERBIUM-170—proton reactions (p,t) at 19 MeV, angular distributions for, (E)
ZINC-68—proton elastic and inelastic scattering at 18.6 MeV, angular distributions for, (E)
ZIRCONIUM-90—proton elastic and inelastic scattering at 18.6 MeV, angular distributions for, (E)
—alpha elastic scattering at 26 to 27.5 MeV, optical-model analysis of, (E/T) (J.W.R.)

16534 PROBABILITY OF PRODUCTION OF INTERNAL BREMSSTRAHLUNG ACCOMPANYING β DECAY FROM ^{90}Sr AND ^{90}Y. Singh, B.; Al-Dargazelli, Shetha S. (Univ. of Baghdad). Phys. Rev., C; 4: No. 6, 2144-9(Dec 1971).

The production of internal bremsstrahlung accompanying β decay from radioactive nuclei of ^{90}Sr–^{90}Y has been studied. The β-active source of ^{90}Sr–^{90}Y is fixed to the source holder of an experimental chamber with good collimating arrangement. The internal bremsstrahlung is detected by a scintillation counter of good resolution and known efficiency, and a differential spectrum is obtained using a single-channel pulse analyzer. After making all necessary corrections, the probability of internal bremsstrahlung in photons/mc^2 per β disintegration is obtained. The experimental probability is compared with the theoretical probability obtained from the theories of Knipp, Uhlenbeck, and Bloch; Nilsson; and Lewis and Ford. At higher energy, where the contribution due to ^{90}Sr is negligible, the experimental probability for ^{90}Y is compared with the theories of Felsner, and Ford and Martin. The experimental probability at higher energy is much less than the theory predicts, in contradiction to the measurement of the previous workers. (auth)

16535 ELASTIC SCATTERING OF ^{16,18}O BY ^{116,120}Sn AT ENERGIES NEAR THE COULOMB BARRIER. Robertson, B. C. (Univ. of Alberta, Edmonton. Brookhaven National Lab., Upton, N. Y.); Sample, J. T.; Goosman, D. R.; Nagatani, K.; Jones, K. W. Phys. Rev., C; 4: No. 6, 2176-80(Dec 1971).

The elastic scattering of ^{16,18}O by ^{116,120}Sn has been studied at energies near the Coulomb barrier. Angular distributions were measured at $E_{c.m.}$ = 57.97 MeV and excitation curves at 75, 80, 85, and 90° from 45 to 68 MeV and from 54 to 67.5 MeV for ^{16,18}O scattered by ^{116}Sn and ^{120}Sn, respectively. A single angular distribution was taken at $E_{c.m.}$ = 48.53 MeV for the scattering of ^{16}O by ^{120}Sn. An optical-model analysis was used to parametrize the data, and evidence is presented for a change in radius between ^{116}Sn and ^{120}Sn, and for a change of diffuseness between ^{16}O and ^{18}O. (auth)

16536 AVERAGE RESONANCE PARAMETERS FOR Ag (NATURAL), ^{107}Ag, ^{109}Ag, ^{197}Au AND ^{160}Gd. Lindsay, James Gordon Jr. Blacksburg, Va.; Virginia Polytechnic Inst. and State Univ. (1971). 105p. University Microfilms Order No. 71-28,945.
Thesis.

The naturally abundant silver element and the isotopes ^{107}Ag, ^{109}Ag, ^{197}Au, and ^{160}Gd were studied to obtain the average s-wave and p-wave neutron strength functions and the average gamma strength functions. These averages were then used to calculate average capture cross sections for the elements. The data were taken using a cadmium- and boron-filtered beam of reactor spectrum neutrons. The amount of ^{10}B in the beam was varied, and the resulting induced activities were correlated to the ratios of radiative capture to neutron scattering widths for s- and p-wave neutrons. This was accomplished by a shape fitting of the experimental curve of activity as a function of the ^{10}B in the beam with theoretical curves assuming the Porter–Thomas distribution of reduced neutron widths. A normalization procedure using the known resonance integral of gold and the thermal cross sections of this and the other nuclides established the values of the gamma ray strength functions, which were then used to find the s- and p-wave strength functions. The analysis was terminated at 100 keV neutron energy to reduce the contributions of neutrons of angular momenta higher than p-wave. From the resonance parameters the average capture cross sections were calculated up to 100 keV neutron energy, and these cross section curves are in agreement with literature values where such exist. (TSS) (Diss. Abstr. Int., B)

16537 COMPACT GRAPHICAL REPRESENTATION FOR γ-RAY DIRECTION CORRELATION COEFFICIENTS FOR ALIGNED NUCLEI. Green, P. W.; Robertson, B. C.; Sheppard, D. M. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 98: No. 1, 45-51(1972).

A graphical method for rapidly extracting possible values of mixing ratio and spin ($J \leqq 10$) from the analysis of a γ-ray direction correlation is presented. (auth)

16538 ISOBARIC ANALOG RESONANCES IN ^{92}Nb. Deconninck, G. (Facultes Univ., Namur, Belg. CPNL, Louvain, Belg.); Royen, J. Ann. Soc. Sci. Brux. Ser. I; 85: No. 2, 181-4(25 Aug 1971). (In French).

Excitation curves for (p,n) reactions on ^{91}Zr were measured. Three resonances were observed at E_p = 3.24, 3.68, and 4.15 MeV; the first and the third of these resonances are the analogs of the ground and first excited states of ^{92}Zr. The second resonance is completely unexpected and has no correspondent in ^{92}Zr. (auth)

16539 NUCLEAR LEVEL STRUCTURE OF ^{101}Ru FROM THE 14.0 MINUTE ^{101}Tc DECAY. Siwamogsatham, Boonsong. Corvallis, Oreg.; Oregon State Univ. (1971). 111p. University Microfilms Order No. 71-25,334.
Thesis.

The nuclear level structure of ^{101}Ru has been investigated through the decay of 14.0 minute ^{101}Tc produced by thermal neutron irradiation of molybdenum targets. Gamma-ray energies and relative intensities have been measured with the high resolution Ge(Li) spectrometers. Based on the energy sum and the intensity balancing, a consistent level scheme of ^{101}Ru is proposed. Origins of spin-parity of the levels in ^{101}Ru are discussed on the ground of de-Shalit weak coupling core excitation model. The results of this study are compared with the recent extended quasiparticle phonon coupling calculations. The γ-ray energies and relative intensities emitted in the decay of 14.6 minute ^{101}Mo have also been measured. Several new γ transitions and level energies have been observed, and a new level scheme of ^{101}Tc is proposed. (Diss. Abstr. Int., B)

16540 MAGNETIC MOMENTS OF EXCITED STATES OF ODD A NUCLEI. Roney, Wayne Mason Jr. Madison, Wis.; Univ. of Wisconsin (1971). 110p. University Microfilms Order No. 71-20,689.

Thesis.

Coulomb excitation-Ion implantation studies were conducted on ^{103}Rh, ^{107,109}Ag, ^{111,113}Cd, ^{123,125}Te and ^{135}Ba. The angular correlation coefficients were measured for implantation into Cu. The electric quadrupole transition strengths (B(E2)'s) were extracted and used in determining the mean lifetimes of the states. The precessions of the states were observed for implantation into a polarized Fe backing. The "transient" field effect for nuclei in this region of Z and the static hyperfine fields for these nuclei as solutes in Fe are known and were used, along with the weighted averages of the reported and measured lifetimes, to extract the gyromagnetic ratios (g-factors) for 13 excited states. The extracted g-factors and their comparison with theoretical predictions are discussed. (Diss. Abstr. Int., B)

16541 ANGULAR CORRELATIONS OF γ CASCADES FOLLOWING THE DECAY OF ^{125g}Sn. Palmer, George Michael. Morgantown, W. Va.; West Virginia Univ. (1971). 165p. University Microfilms Order No. 71-26,639.

Thesis.

Gamma-gamma directional correlation measurements have been made on several gamma cascades in ^{125}Sb which follows the beta decay of 9.6 day ^{125}Sn. Using 20 cm^3 Ge(Li) and 3 × 3 inch NaI(Tl) detectors the 822-1066, 915-1066, 1173-1066, 1221-1066, 1087-332, 469-1087, 800-1089, 893-1089, 1151-1089, and 469-1419 keV gamma cascades were investigated. The results are consistent with the spin assignments $^7/_2{}^+$, $^5/_2{}^+$, $^3/_2{}^+$, $^{11}/_2{}^+$, $^7/_2{}^+$, $^{11}/_2{}^+$, $^{13}/_2{}^+$, $^{11}/_2{}^\pm$, or $^{13}/_2{}^+$, and $^{11}/_2{}^\pm$ to the ground state, 332, 1066, 1089, 1419, 1890, 1982, 2239, and 2287 keV levels respectively. The 469, 915, and 1089 keV gamma rays were found to be pure E2 radiation while the 332, 800, 822, 893, 1066, 1087, 1221, and 1419 keV gamma rays were found to be <1% E2, 56.5 ± 3.5% E2, 7 ± 1% E2, 48 ± 29% E2, 84.5 ± 1.5% E2, 96 ± 1% E2, 15 ± 4% quadrupole and 81 ± 4% E2 respectively. The quadrupole intensities of the 1151 and 1173 keV gamma rays are 12.5 ± 11.5% and 7 ± 3% quadrupole radiations with $^{11}/_2{}^\pm$ assignment to 2239 keV level and 47.5 ± 22.5% E2 and 100% E2 with $^{13}/_2{}^+$ assignment to 2239 keV level. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 16518, 16522, 16536, and 16578.

16542 (ANCR-1016, pp 27-89) NUCLEAR PROPERTIES. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

DYSPROSIUM-160—energy-level transitions from terbium-160 beta decay, internal conversion coefficients and multipolarities for, (E)
IRIDIUM-192—beta and electron-capture decay of, conversion-electron spectra from, (E)
LANTHANUM-141—energy levels from barium-141 beta decay, (E)
LANTHANUM-142—energy levels from barium-142 beta decay, (E)
OSMIUM-192—energy level transition from iridium-192 decay, relative internal conversion coefficients for, (E)
PLATINUM-192—energy-level transitions from iridium-192 beta decay, relative internal conversion coefficients for, (E)
SCANDIUM-44—beta and electron-capture decay of ground-state and isomeric, branching ratios and gamma spectra from, (E)
—isomeric transition in, branching ratio and conversion coefficients for, (E)
—energy-level transitions from titanium-44 electron-capture decay, conversion coefficients for, (E)
TERBIUM-160—beta decay of, conversion-electron and gamma spectra from, (E)
THORIUM-229—energy levels from uranium-233 alpha decay, spin-parity assignments for, (E)
—energy-level transitions from uranium-233 alpha decay, branching ratios and intensities for, (E)
THORIUM-231—energy levels from uranium-235 alpha decay, Nilsson and spin-parity assignments for, (E)
—energy-level transitions from uranium-235 alpha decay, branching ratios and intensities for, (E)
TITANIUM-44—electron-capture decay of, gamma spectra from, (E)
TUNGSTEN ISOTOPES—neutron capture at thermal energies and 2 keV, gamma spectra from, (E)
TUNGSTEN-182—neutron capture at thermal energies and 2 keV, gamma spectra from, (E)
TUNGSTEN-183—neutron capture at thermal energies and 2 keV, gamma spectra from, (E)
—energy levels from tungsten-182 neutron capture, spin-parity assignments for, (E)
TUNGSTEN-184—energy levels from tungsten-183 neutron capture, spin-parity assignments for, (E)
—energy-level transitions from tungsten-183 neutron capture, reduced probabilities for, (E)
URANIUM-233—alpha decay of, gamma spectra from, (E)
URANIUM-235—alpha decay of, gamma spectra from, (E)
YTTERBIUM-171—neutron capture at thermal energies and 2 keV, gamma spectra from, (E)
YTTERBIUM-173—neutron capture at thermal energies and 2 keV, gamma spectra from, (E) (R.W.R.)

16543 INVESTIGATION OF THULIUM α EMITTERS: NEW ISOTOPES, ^{155}Tm AND ^{156}Tm. Toth, K. S. (Oak Ridge National Lab., Tenn.); Hahn, R. L.; Ijaz, M. A. Phys. Rev., C; 4: No. 6, 223-20(Dec 1971).

The α decay of the previously unknown isotopes ^{155}Tm and ^{156}Tm was observed. These thulium nuclides were produced by bombarding targets of ^{144}Sm and ^{147}Sm with 103-MeV ^{14}N ions accelerated in the Oak Ridge isochronous cyclotron. Supplementary data were also obtained by irradiating ^{162}Er with 110-MeV ^{3}He particles. The experimental apparatus used in this study is based on the idea of stopping recoil products in helium gas. The stopped recoils are then swept out through a small orifice and deposited on a wheel which, after bombardment, conveys the collected radioactivity to a position in front of a Si(Au) detector for the assay of α activity. Three new α emitters were observed. Their decay characteristics and mass assignments (made on the basis of yield-curve measurements and parent-daughter relationships) are as follows: (1) ^{155}Tm, E_α = 4.45 ± 0.01 MeV, $T_{1/2}$ = 39 ± 3 sec; (2) ^{156}Tm (low-spin isomer), E_α = 4.23 ± 0.01 MeV, $T_{1/2}$ = 80 ± 3 sec; and (3) ^{156}Tm (high-spin isomer), E_α = 4.46 ± 0.01 MeV, $T_{1/2}$ = 19 ± 3 sec. (auth)

16544 MEASUREMENT OF THE GYROMAGNETIC RATIO OF THE 316 keV $^7/_2{}^+$ STATE OF ^{169}Tm. Nigam, A. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys.; A181: No. 1, 298-304(1972).

Using the differential angular correlation method (DDCA) and a magnetic field of about 5.93 kG, the nuclear g-factor of the 316 keV $^7/_2{}^+$ level ($T_{1/2}$ = 0.66 μsec) in ^{169}Tm has been measured to be g = 0.044 ± 0.002. The magnetic moment of the level comes out to be μ = 0.154 ± 0.008 nm. (auth)

16545 TWO-NEUTRON TRANSFER REACTION AMONG SAMARIUM NUCLEI. Lee, Eddington Ying-teng. Amherst, Mass.; Univ. of Massachusetts (1971). 248p. University Microfilms Order No. 71-25,079.

Thesis.

The isotopes of samarium span the transition region from the spherical to a deformed nuclear shape. The change in the coupling scheme near N = 88 is most easily demonstrated by the energy levels of the even Sm isotopes. The coherent, two-neutron transfer (p,t) reaction was therefore chosen as a probe to study the structure of ^{146}Sm, ^{148}Sm, and ^{150}Sm nuclei. The proton beams of 20 and 19 MeV were used to initiate the (p,t) reactions on ^{148,150,152}Sm targets and the reaction tritons were analyzed in a multigap magnetic spectrograph using emulsion techniques. Levels up to 3 MeV excitation were determined and their angular distributions obtained. The direct reaction mechanism seems to be dominant for these reactions at proton energy of about 20 MeV. However, the disagreement between the results of the distorted-wave-Born-approximation and the triton angular distributions when L ≠ 0 suggests that the inelastic process is playing a significant role. The (p,t) reactions have excited many previously unobserved 0^+ states. These appear to support the neutron pairing-vibration model. The level scheme of the ^{146}Sm nucleus is well explained by the unified model with intermediate coupling. The model of the asymmetric rotor with vibrational degrees of freedom partially accounts for the level scheme of ^{148}Sm but seems inappropriate for the ^{150}Sm nucleus. (Diss. Abstr. Int., B)

16546 ANGULAR CORRELATION OF GAMMA RADIATION AND THE LIFETIME OF THE LEVELS OF THE ^{187}Re NUCLEUS. Begzhanov, R. B.; Gladyshev, D. A.; Kobilov, O. Sh.; Radzhapov, P. S.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 81-6 (1971). (In Russian).

Excited ^{187}Re was formed from decaying ^{187}W (from neutron irradiation of enriched ^{186}W), and a fast-slow coincidence circuit was used to investigate the γ-γ angular correlation of the cascade

radiation at 745–134, 552–134, and 72–134 keV. The ground state of the ^{187}Re nucleus was in agreement with the experimental value of the electric quadrupole moment. The decay scheme of ^{187}W is presented. (K.S.W.)

16547 NEUTRON CAPTURE CROSS SECTIONS IN THE keV REGION FOR ^{154}Sm, ^{160}Gd, ^{164}Dy, AND ^{165}Ho. Fawcett, Louis Raymond Jr. Blacksburg, Va.; Virginia Polytechnic Inst. and State Univ. (1971). 85p. University Microfilms Order No. 71-28,931.

Thesis.

Neutron-capture cross sections for ^{154}Sm, ^{160}Gd, ^{164}Dy, and ^{165}Ho were investigated in the energy range from 5 to 160 keV. After activation of the metal samples, the decay products were counted with a well-type plastic scintillator. Samples were activated by neutrons generated by the ^{7}Li(p,n)^{7}Be reaction, with the samples being placed at 90° with respect to the neutron target. From the experimental cross section curves S_γ, the γ-ray strength function; S_0, the s-wave neutron strength function; and S_1, the p-wave neutron strength function were determined. (TSS) (Diss. Abstr. Int., B)

16548 MEASUREMENT OF ELECTRIC HYPERFINE INTERACTIONS IN TUNGSTEN BRONZES BY ANGULAR CORRELATION TECHNIQUES. Roper, John Gordon. Pullman, Wash.; Washington State Univ. (1971). 98p. University Microfilms Order No. 71-28,794.

Thesis.

The angular correlation of the 480- and 72-keV gamma rays emitted in the decay of ^{187}Re was studied with the rhenium imbedded in tungsten metal, tungstic oxide (WO_3), and sodium tungsten bronze (Na_x-WO_3) lattices. Static electric hyperfine interactions were observed in all compounds of tungsten but not in metallic tungsten. Differential angular correlation measurements made using polycrystalline powder sources of tungsten metal were found to be unattenuated over a time interval of 0.0 to 0.40 microseconds. The measured angular correlation coefficients ($A_{22} = -0.136 \pm 0.011$) were in excellent agreement with the theoretical value, $A_{22} = -0.1309$, for pure E2 and E1 assignments, respectively, of the multipolarities of the 480- and 72-keV transitions. Static electric hyperfine interactions were observed in polycrystalline powder samples of Na_xWO_3 having sodium concentrations x = 0.4, 0.6, 0.7, and 0.9. The interaction strength was found to be only weakly dependent on the sodium concentration in these samples. The results indicated that the conduction electron density in the vicinity of the sodium ions was very insensitive to the sodium concentration. These results are consistent with models for the bronzes which predict that the conduction electrons are highly-localized in the vicinity of the sodium ions. The magnitudes of the spectroscopic and intrinsic electric quadrupole moments of the 206-keV $^9/_2^+$ $^9/_2$ [514] Nilsson state in ^{187}Re were also obtained using the results of the impurity shielding calculations that had been corrected for Sternheimer shielding. These calculations yielded a spectroscopic moment $|Q| = 5.09 \pm 1.30$ barns and an intrinsic moment $|Q_0| = 9.33 \pm 2.38$ barns. Comparison with the intrinsic quadrupole moment of the $^1/_2$–$^7/_2$[402] ground state in ^{187}Re(Q_0 = 5.75 barns) indicated that the rhenium nucleus undergoes a large change in deformation in transitions between the [402] and [514] rotational bands. Static electric hyperfine interactions were also observed in both annealed and nonannealed tungstic oxide samples. The annealing of the samples had no effect on the experimental results; hence any radiation damage occurring at the time of irradiation self-anneals rapidly at room temperature. The electric field-gradient at the site of the rhenium nucleus was calculated using the measured electric quadrupole interaction frequencies. These calculations yielded a value of $1.60 \pm 0.19 \times 10^{17}$ volts/centimeter^2 for the field-gradient. (Diss. Abstr. Int., B)

16549 ENERGY RELATION OF THE ANGULAR ANISOTROPY OF ^{188}Os FRAGMENTS DURING FISSION BY α-PARTICLES. Kuvatov, K. G.; Smirina, L. A.; Okolovich, V. N.; Prokof'ev, S. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 78-80(Mar-Apr 1971). (In Russian).

The energy dependence of the angular anisotropy of fragments was measured during the fission of ^{188}Os by α particles which had energies from 31 to 38 MeV. Glass cylinders served as fission-fragment detectors. The resulting data did not indicate a deviation from the Fermi-gas dependence of angular anisotropy of fission fragments in this range of excitation energies. (2 figures, 1 table) (tr-auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 16499, 16520, 16533, and 16536.

16550 RESONANCE PROCESSES AND NUCLEAR EXCITATION IN MUONIC ^{205}Tl. Chen, M. Y.; Cheng, S. C.; Lee. W. Y.; Rushton, A. M.; Wu, C. S. (Columbia Univ., New York). Nucl. Phys.; A181: No. 1, 25-32(1972).

The L and K x rays of muonic ^{205}Tl have been measured with an enriched (99.8%) ^{205}Tl target. Two sets of resonance processes were included in the analysis, which led to satisfactory fits to the experimental spectra, and explain the anomalous intensity ratios between the fine structure components of the muonic L and K x rays. At the same time, the M1 hyperfine structure constants, which show the finite distribution of the nuclear M1 moment, were determined. Also determined were the static nuclear E2 and M1 moments of the excited states. (auth)

16551 NUCLEAR EXCITATION IN MUONIC ^{209}Bi. Lee, W. Y.; Chen, M. Y.; Cheng, S. C.; (and others) (Columbia Univ., New York). Nucl. Phys.; A181: No. 1, 14-24(1972).

The hyperfine spectra of muonic L and K x rays of ^{209}Bi have been reanalyzed by taking into account the resonance processes and the observed isomer shifts in addition to the M1 and the E2 interaction. The M1 and E2 hyperfine structure constants of the 1s, 2p and 3d muonic states and the nuclear static moments of the excited states $^{15}/_2^+$ and $^9/_2^+$ are determined from the best fits to the experimental spectra. The hfs constants and the M1 moments are in good agreement with theoretical predictions from the core excitation model. The quadrupole moment of the ground state remains to be 20% higher than that determined by the atomic beam method. A plausible interpretation is that this discrepancy might be due to the deformation of the lead core. (auth)

16552 SEARCH FOR ISOMERISM IN ^{193}Os. Loebner, K. E. G.; Bunker, M. E.; Starner, J. W. (Los Alamos Scientific Lab., N. Mex.). Nucl. Phys.; A181: No. 1, 11-13(1972).

The recently reported β activity from an isomeric state in ^{193}Os with a half-life of 17 ± 1 min could not be confirmed. It was found that prior to chemical purification, samples of isotope-separated ^{192}Os that have been irradiated with thermal neutrons are contaminated with 17.6 min ^{80}Br, which accounts for the reported 17 min activity. (auth)

16553 g-FACTOR OF THE 130 keV STATE IN ^{195}Pt MEASURED BY THE MOESSBAUER EFFECT. Wolbeck, B.; Zioutas, K. (Univ., Bonn). Nucl. Phys.; A181: No. 1, 289-97(1972).

Using the Mössbauer effect of the 130-keV transition in ^{195}Pt, the g-factor of the first $^5/_2^-$ level in ^{195}Pt was derived from magnetic hyperfine splitting in a Pt–Fe alloy: $g(^5/_2^-) = 0.35 \pm 0.042$. The known g-factors of the $^1/_2^-$ ground state and the 99 keV $^3/_2^-$ state made it possible to determine the magnetic field at the site of the Pt nucleus with high accuracy. The experimental line-widths of the resonance curves are in excellent agreement with lifetime measurements. Comparison of the isomer shift measurements of the 99 keV and the 130 keV transitions give $(\Delta\langle r^2\rangle_{130}/\Delta\langle r^2\rangle_{99}) = 1.61 \pm 0.20$. The experimental results are compared with theoretical calculations. (auth)

16554 TWO-PARTICLE STATES IN ^{210}Pb, ^{210}Bi, AND ^{210}Po WITH REALISTIC FORCES. Herling, G. H. (State Univ. of New York, Stony Brook. Naval Research Lab., Washington, D. C.); Kuo, T. T. S. Nucl. Phys.; A181: No. 1, 113-31(1972).

Two-particle states in ^{210}Pb, ^{210}Bi, and ^{210}Po have been calculated with reaction matrix elements deduced from the Hamada–Johnston potential. The inclusion of core polarization is essential for reproducing experimental spectra. Some qualitative aspects of the effective interaction are discussed. (auth)

16555 ^{197}Au(n,γ)^{198}Au CROSS-SECTION AT 22.8 keV. Ryves, T. B.; Robertson, J. C. (National Physical Lab., Teddington, Eng.). J. Nucl. Energy; 25: No. 11, 557-62(Nov 1971).

A new measurement of the ^{124}Sb γ-ray energy is given and this together with other recent precise measurements is used to obtain the Sb–Be photoneutron energy. New Monte Carlo calculations of the neutron energy spectrum from an Sb–Be photoneutron source are presented. Taking these factors into account, a re-evaluation of the ^{197}Au(n,γ)^{198}Au cross-section measured by Ryves et al. (1966) is given and compared with recent time-of-flight measurements. (auth)

16556 ANALYSIS OF MUONIC-ATOM ISOMER SHIFTS IN ^{209}Bi AND ^{207}Pb. Rinker, George A. Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., C; 4: No. 6, 2150-64(Dec 1971).

The observed muonic-atom isomer shifts in ^{209}Bi and ^{207}Pb are analyzed in terms of a single particle or hole coupled to collective vibrations of the nuclear core by means of the weak-coupling Hamiltonian of Bohr. The isomer shift is a delicate effect which is sensitive to certain details of nuclear structure. Although the data for these two nuclei are limited, they strongly suggest two

conclusions: (1) that vibrational excitation is not strictly volume conserving, but results in a slight increase of nuclear volume; and (2) that the proton core reacts significantly to changes in state of the valence particle, in a way which is not accounted for by the present model. This reaction is found to be stronger in the case of a valence neutron that in the case of a valence proton. In addition, the Ford–Wills radial-moment analysis is found to be adequate for the analysis of isomer shifts, though the refined method of Barrett is superior. As a byproduct of this work, nuclear wave functions are obtained which may be useful for other applications. (auth)

16557 EXCITATION FUNCTION AND RECOIL RANGES OF ^{211}At PRODUCED THROUGH ^{40}Ar + ^{209}Bi TRANSFER REACTIONS. Bimbot, R.; Gardes, D.; Rivet, M. F. (Institut de Physique Nucleaire, Orsay, France). Phys. Rev., C; 4: No. 6, 2180–4(Dec 1971).

The excitation function and projected recoil ranges for ^{211}At produced through ^{40}Ar + ^{209}Bi reactions have been measured for ^{40}Ar beam energies from 190 to 270 MeV. A substantial value (25 mb) was found for the cross section at high energies. The general features of the reaction (excitation function, magnitude of the cross section, variation of recoil range versus incident energy) are very similar to the results for lighter projectiles, and show unambiguously a non-compound-nucleus process. The possibility that various transfer mechanisms may lead to ^{211}At is discussed with the help of a kinematic analysis. (auth)

16558 EXPERIMENTS ON PARITY NONCONSERVATION IN NUCLEAR FORCES. II. GAMMA TRANSITIONS IN ^{203}Tl AND ^{75}As. Vanderleeden, J. C.; Boehm, F.; Lipson, E. D. (California Inst. of Tech., Pasadena). Contract AT(04-3)-63. Phys. Rev., C; 4: No. 6, 2218–23(Dec 1971).

The circular polarization P_γ of the 279-keV γ ray in ^{203}Tl and the 401-keV γ ray in ^{75}As has been measured using a Compton polarimeter and a current-measuring technique. The result for ^{203}Tl is $P_\gamma = (2 \pm 5) \times 10^{-6}$. For ^{75}As evidence for a nonzero circular polarization, $P_\gamma = (-0.6 \pm 0.2) \times 10^{-4}$, is found. The role of the electron-capture bremsstrahlung in the case of ^{75}As is discussed. (auth)

16559 ROLE OF PAIRING IN THE FORMATION OF DOUBLE-ANALOG STATES IN HEAVY NUCLEI. Miller, G. A.; Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Phys. Rev. Lett.; 28: No. 6, 372–5(7 Feb 1972).

The proton entrance width for formation of double-analog states in heavy nuclei is studied. A channel-coupling term gives the dominant contribution to this isospin-forbidden width. Pairing correlations in the parent nucleus enhance this width by a large factor. It is about 80 eV for the double analog of the ground state of ^{210}Pb, and larger (1 keV) in the region of the tin isotopes. (auth)

16560 NUCLEAR ENERGY LEVELS OF ^{192}Pt AND ^{194}Pt. Benson, Gerald Don. Nashville; Vanderbilt Univ. (1971). 144p. University Microfilms Order No. 71-29,290.

Thesis.

The gamma rays emitted in the decay of ^{194}Au to ^{194}Pt were studied by means of a Ge(Li) detector and a 4096-channel analyzer system. The energies and relative intensities of the gamma rays were determined from singles measurements. Two-parameter gamma–gamma coincidence measurements were made by means of two Ge(Li) detectors and a multiparameter analyzer system. The coincidence relationships discovered were used to construct the nuclear energy level scheme of ^{194}Pt. The measured gamma-ray intensities were used in the calculation of K-conversion coefficients for many of the transitions. These coefficients were used to determine transition multipolarities and thus to determine the spin and parity assignments of some of the levels. The energy level scheme consists of thirty-six excited states, six of them previously unreported. Five levels reported in previous work were removed from the level scheme. The same experimental techniques were used to study the decay of ^{192}Au to ^{192}Pt. An energy level scheme consisting of forty-two excited states was constructed, including many changes in the previous level scheme. The properties of the energy levels of ^{192}Pt and ^{194}Pt were compared to those predicted by the vibrational model of the nucleus. Evidence was found for the interpretation of several low-energy levels in terms of this model. In both ^{192}Pt and ^{194}Pt, levels were found which could be interpreted as the one-phonon state, two of the predicted triplet of two-phonon states, and three of the predicted quintet of three-phonon states. In addition, in ^{194}Pt a possible four-phonon state was found. Comparisons to a pairing-plus-quadrupole model were also made. Quantitative agreement with this model was not found for either ^{192}Pt or ^{194}Pt. (Diss. Abstr. Int., B)

16561 DIAGRAMATIC PERTURBATION TREATMENT OF THE EFFECTIVE INTERACTION BETWEEN TWO-PHONON STATES IN CLOSED SHELL NUCLEI: THE $J^\pi = 0^+$ STATES IN ^{208}Pb. Broglia, R. A. (Univ. of Copenhagen. State Univ. of New York, Stony Brook); Paar, V.; Bes, D. R. Contract AT (30-1)-4032. Phys. Lett.; 37B: No. 2, 159–65(15 Nov 1971).

A unified picture is presented for describing the closed shell nuclear spectrum, in particular, those states that are strongly excited in the (t,p), (p,t) reactions and/or inelastic scattering processes. In the shell-model language these are the 2p, 2h and 1p–1h states (pairing and surface vibrational states), and those generated by coupling these states among themselves (two-phonon states). In the collective model the 2p, 2h and 1p–1 h states are usually referred to as the elementary excitations of the closed shell systems. The coupling between the elementary excitations is treated microscopically in perturbation theory (anharmonicities of the phonon nuclear spectrum) and an effective interaction among the phonons is obtained. In particular, the interaction among the $J^\pi = 0^\pi$ states $|gs(^{206}Pb) \otimes gs(^{210}Pb); 0\rangle$ and $|3^-(^{206}Pb) \otimes 3^-(^{206}Pb); 0\rangle$ are calculated and the results compared with the ^{206}Pb(t,p) and ^{210}Pb(p,t) reaction data. (auth)

16562 MAGNETIC MOMENT OF THE 12^- ISOMER OF ^{196}Au. Bacon, F.; Kaindl, G.; Mahnke, H.-E.; Shirley, D. A. (Univ. of California, Berkeley). Phys. Lett.; 37B: No. 2, 181–2 (15 Nov 1971).

The magnetic hyperfine interaction of the 12^- state of ^{196}Au in Fe and Ni has been determined by low-temperature nuclear orientation. A value of $\mu(12^-) = \pm 5.35 \pm 0.20$ n.m. was derived by using the hyperfine fields of ^{197,198}Au(Fe) and correcting for hyperfine anomalies. (auth)

16563 ANGULAR CORRELATION TEST OF TIME REVERSAL INVARIANCE. Holmes, M. J.; Hamilton, W. D.; Fox, R. A. (Univ. of Sussex, Brighton, Eng.). Phys. Lett.; 37B: No. 2, 170–2(15 Nov 1971).

The angular correlation between the 300 keV and 600 keV groups of γ-rays occurring in ^{192}Pt following the β-decay of ^{192}Ir has been measured with a polarized source. An asymmetry in the correlation of $A = (3.0 \pm 3.3) \times 10^{-4}$ was obtained which corresponds to a phase difference between the multipole components of the mixed transitions in the cascades of $\eta = (5 \pm 6) \times 10^{-3}$. Although this experiment is more accurate than preceding correlation tests, it contains no evidence for T-violation and indeed theoretical estimates are at least an order of magnitude lower. (auth)

16564 NEUTRON BOUND S STATES IN WOODS–SAXON POTENTIAL. Ganguly, Chhaya (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 44: No. 4, 253–7(Apr 1970).

The s-wave bound states of neutrons in a Woods–Saxon potential were investigated by calculating the zeros of the S_0 matrix on the negative imaginary axis of the complex k plane. Numerical results are presented for the atomic mass A = 200. (auth)

16565 NEUTRON ACTIVATION CROSS SECTIONS AT 14.4 MeV FOR SOME NATURALLY-OCCURRING HEAVY ELEMENTS IN THE REGION $76 \leq Z \leq 82$. Hankla, Alice Clair Kimbler. Nashville; Vanderbilt Univ. (1971). 155p. University Microfilms Order No. 71-29,302.

Thesis.

Neutron activation cross sections at 14.4 MeV were determined for isotopes of the following naturally-occurring heavy elements: osmium, platinum, gold, mercury, thallium, and lead. These cross sections, measured by the mixed-powder method with Ge(Li) gamma detection first developed by Rao and Fink, are as follows. For (n,2n) reactions (m = metastable; g = ground-state): ^{192}Os, 1993 ± 200(m+g); ^{192}Pt, 2035 ± 150; ^{196}Pt, 1009 ± 100(m); ^{196}Pt, 707 ± 85(g); ^{197}Au, 151 ± 18(m); ^{197}Au, 1986 ± 150(m+g); ^{196}Hg, 1617 ± 160(m); ^{196}Hg, 363 ± 54(g); ^{198}Hg, 885 ± 80(m); ^{198}Hg, 1125 ± 100(g); ^{200}Hg, 789 ± 120(m); ^{204}Hg, 2077 ± 166; ^{203}Tl, 1950 ± 200; ^{204}Pb, 1737 ± 140; (n,n′) reactions: ^{199}Hg, 128 ± 20(m); ^{204}Pb, 51 ± 10(m); (n,3n) reactions: ^{197}Au, 61 ± 20; (n,p) reactions: ^{194}Pt, 4.3 ± 0.6; ^{198}Pt, 1.1 ± 0.2; ^{198}Hg, 4.5 ± 0.5; ^{199}Hg, 2.3 ± 0.3; ^{208}Pb, 0.46 ± 0.06; (n,α) reactions: ^{203}Tl, 2.2 ± 0.4; [(n,np) + (n,pn) + (n,d)] reaction: ^{199}Hg, 0.40 ± 0.06. By the use of the measured cross sections from the present work as a basis of comparison with calculated cross sections, an empirical study of the dependence of (n,2n) and (n,3n) cross sections upon level density parameter expressions was made. The quantities considered in this expression included the atomic mass, shell corrections, pairing interaction corrections, and the average effective angular momentum. No simple dependence of (n,2n) cross sections on any of the level density parameters tried was observed. It is therefore concluded that measurements of activation

cross sections at a single neutron energy are not an effective, sensitive method of finding a direct relationship among the factors that determine the nuclear level density parameter. As a continuation of the empirical study of the forms of the level density parameter expressions, (n,p) cross section calculations were made in which three of these level density parameters were used in the ratio equation of Gardner and Rosenblum to predict relative (n,p) cross sections. Cross sections calculated with the statistical-model equation of Pearlstein and the optimized level density parameter equation were compared with a consistent set of measured (n,2n) values over the region $30 \leq Z \leq 82$; the deviations of the calculated cross sections from the respective measured values were analyzed as a test of the applicability of the continuum theory of the compound nucleus to describe the true reaction mechanism which occurs, and hence to make accurate (n,2n) and (n,3n) cross section predictions. From the relative gamma ray intensity method, the total conversion coefficient for the ($^{13}/_{2}^{+} \rightarrow {}^{5}/_{2}^{-}$) 375-keV isomeric transition in 43-min. ^{199m}Hg decay was measured to be 6.72 ± 0.34. This transition was assigned pure M4 multipolarity by comparison of this conversion coefficient with the theoretical value from Hager and Seltzer. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 15360, 16140, 16499, 16862, 16873, and 17109.

16566 (ANCR-1016, pp 1-26) NEUTRON INTERACTIONS WITH NUCLEI. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

CURIUM ISOTOPES—neutron reactions (n,f) at 1.1 to 214 eV, transmission curves for, (E)
CURIUM-243—energy levels of, resonance parameters for, (E)
CURIUM-244—energy levels of, resonance parameters for, (E)
—energy levels from neutron reactions, resonance parameters for, (E)
CURIUM-245—energy levels of, resonance parameters for, (E)
CURIUM-246—energy levels of, resonance parameters for, (E)
FISSION PRODUCTS—activities from thermal-neutron reactions with uranium-235, (E)
NUCLEI—neutron capture by A = 87 to 169, averaged cross sections for pile, (E)
PLUTONIUM-242—energy levels from neutron reactions, resonance parameters for, (E) (R.W.R.)

16567 (ORO-4028-1) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report. Gordon, G. E.; Viola, V. E. Jr.; Walters, W. B. (Maryland Univ., College Park. Dept. of Chemistry). [1971]. Contracts AT(40-1)-3783; AT(40-1)-4028; AT(40-1)-4187. 67p. Dep. NTIS.

ACTINIDES—fission of, predicted half-lives for spontaneous, (T)
ACTIVATION ANALYSIS—development for studies on environmental samples
AEROSOLS—analysis of atmospheres, by instrumental neutron activation methods
AIR—analysis for trace amounts of elements by instrumental neutron activation methods
—analysis for alpha sources
ALPHA SOURCES—determination in air
ALUMINUM—determination in atmospheric aerosols by instrumental neutron activation methods
ANTIMONY-127—energy levels from tin-127 beta decay, spin-parity assignments for, (E)
BISMUTH-209—alpha fission at 140 MeV, angular correlations and fragment angular and energy distributions from, (E)
BROMINE—determination in atmospheric aerosols by instrumental neutron activation methods
CHLORINE—determination in atmospheric aerosols by instrumental neutron activation methods
ELEMENT 104—fission of, predicted half-lives for spontaneous, (T)
FISSION FRAGMENTS—angular distributions from alpha fission of bismuth-209 and uranium-238 at 140 MeV, (E)
MANGANESE—determination in atmospheric aerosols by instrumental neutron activation methods
NUCLEAR CHEMISTRY—equipment and facilities development for research on
NUCLEI—alpha decay of A = 140 to 310, predicted Q values for, (E)
POLONIUM ISOTOPES—fission of, predicted half-lives for spontaneous, (T)
SODIUM—determination in atmospheric aerosols by instrumental neutron activation methods
THORIUM-232—alpha reactions (α,xn) at 140 MeV, alpha spectra from, (E)
TIN-127—beta decay of, branching ratios, log-ft values, and Q value for, (E)
TRANSACTINIDE ELEMENTS—fission of, predicted barriers for, (T)
URANIUM-238—alpha fission at 140 MeV, angular correlations and fragment angular and energy distributions from, (E)
VANADIUM—determination in atmospheric aerosols by instrumental neutron activation methods (R.W.R.)

16568 NEW ISOTOPES ^{29,30}Mg, ^{31,32,33}Al, ^{33,34,35,36}Si, ^{35,36,37,38}P, ^{39,40}S, AND ^{41,42}Cl PRODUCED IN BOMBARDMENT OF A ^{232}Th TARGET WITH 290 MeV ^{40}Ar IONS. Artukh, A. G.; Avdeichikov, V. V.; Gridnev, G. F.; (and others). (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A176: No. 2, 284-8(1971).

Seventeen new nuclides, ^{29,30}Mg, ^{31,32,33}Al, ^{33,34,35,36}Si, ^{35,36,37,38}P, ^{39,40}S, and ^{41,42}Cl, together with other, already known nuclides, were detected and identified in bombardment of a ^{232}Th target with 290-MeV ^{40}Ar ions. The charged-particle identification system combining the magnetic analysis and the $\Delta E-E$ technique was used. The resolving power of the system was good enough to resolve isotopes of argon. (auth)

16569 STUDIES OF THE TIMES OF EMISSION AND MULTIPLICITIES OF K X RAYS FROM FISSION FRAGMENTS OF SPECIFIED ATOMIC NUMBERS. Kapoor, S. S.; Kataria, S. K.; Murthy, S. R. S.; (and others) (Bhabha Atomic Research Centre, Trombay, India). Phys. Rev., C; 4: No. 6, 2165-75(Dec 1971).

The average emission times of K x rays emitted from ^{236}U fission fragments and the multiplicities of K x rays from ^{252}Cf fission fragments of specified atomic numbers have been determined. The average emission lines of K x rays from ^{236}U fragments were determined by detecting the x rays in the two cases of the emitting fragments moving towards and away from the x-ray detector in the time ranges of 110 and 1000 nsec after fission. The most striking delayed K x-ray emitter is found to be $_{52}$Te, wherein (79 ± 5)% of the K x rays are emitted in the time interval 110–1000 nsec. Information about the cascade emission of K x rays from ^{252}Cf fission fragments of specified atomic numbers was obtained by measuring the energy spectra of coincident K x rays with two Si(Li) x-ray detectors operated in coincidence with each other and with fission. From the analysis of these spectra the first and second moments of the x-ray emission distribution function were determined. A noteworthy feature of these results is that there exists a significantly large probability for a cascade emission of K x rays in several cases. The cascade emission is found to be, in general, more predominant in the heavy-fragment group as compared to the light-fragmented group. In the heavy group, a strong odd–even effect is reflected on the cascade-emission probability. The observed effect on the average K x-ray yield per fragment, if only those events are selected in which the complementary fragment charge has emitted a K x ray, is also discussed. (auth)

16570 PRECISION MEASUREMENT OF GAMMA RAY ENERGIES FROM ^{238}U DAUGHTERS. Sampson, T. E. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 98: No. 1, 37-40(1972).

Precision measurements of gamma ray energies from the ^{234m}Pa and ^{234}Pa daughters in equilibrium with a ^{238}U source are reported. The energies of eight prominent peaks in the spectrum from a ^{238}U source in the energy region from 740 to 1200 keV are presented with assigned errors ranging from 20 eV to 36 eV. (auth)

16571 EVALUATION OF NEUTRON CROSS SECTIONS OF ^{241}Pu IN UNRESOLVED RESONANCE REGION. Takano, Hideki (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 8: No. 11, 656-60(Nov 1971).

Neutron capture, fission, and total cross sections for ^{241}Pu in the unresolved resonance region are constructed and compared with previously reported values. Average resonance parameters, fission widths, and barrier positions are tabulated. The value for the fission resonance integral from 0.5 eV to 10 keV, 566 b, is in reasonable agreement with experimental results. (3 figures, 4 tables) (R.W.R.)

16572 AVERAGE KINETIC ENERGY OF FRAGMENTS FROM THE FISSION OF ^{232}Th BY α-PARTICLES. Okolovich, V. N.;

Pavlov, A. F. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 44-8(Mar-Apr 1971). (In Russian).

The average kinetic energy of the fragments from the fission of ^{232}Th by α-particles was measured. The α-particle energies were 23.2, 27.8, 32.8, and 37.8 ± 0.3 MeV, as measured with surface-barrier detectors with a working surface of 2 cm^2. The $\bar{E}_k^{\alpha}$ was compared with measurements of $\bar{E}_k^n$ for ^{235}U fission in the same geometry. The results of the $\bar{E}_k^{\alpha}$ measurement show an increase of $\bar{E}_k^{\alpha}$ in comparison with $\bar{E}_k^n$ at the same excitation energy of the compound nucleus, showing that the angular momentum imparted to the nucleus is reflected in the kinetic energy of the fragments. (2 figures, 1 table) (tr-auth)

Nuclear Theory

Refer also to abstracts 16135, 16482, 16498, 16859, and 16861.

16573 SOLUTION OF THE REACTION MATRIX EQUATION IN NUCLEAR MATTER. Ulehla, I. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; A181: No. 1, 262-72(1972).

A new and simple method of solution of the reaction matrix equation for the nuclear matter is given. The two-nucleon interaction is taken as a soft-core potential with low singularity in the origin. As an example the method is applied for the interaction acting in the lowest orbital state of the two-nucleon system. (auth)

16574 COULOMB ENERGIES OF SPHERICAL NUCLEI. Jaenecke, Joachim (Univ. of Michigan, Ann Arbor). Nucl. Phys.; A181: No. 1, 49-75(1972).

A phenomenological Coulomb energy equation has been derived for spherical nuclei with diffuse surfaces. Contributions from the direct and exchange Coulomb energy and from the electromagnetic spin-orbit interaction are included explicitly. The experimental Coulomb displacement energies of 42 essentially spherical nuclei with $Z \geq 28$ have been subjected to a least-squares analysis with the shape parameters of the ground state charge distributions required to agree with those obtained from electron scattering and muon capture X-ray experiments. Agreement between the experimental and calculated energies with a standard deviation of about 20 keV is obtained if (i) the ratio between the rms radii of the neutron excess and the proton core is taken between about 1.10 and 1.15, (ii) a smoothly A-dependent correction term which varies between about +450 keV in the light nuclei and +350 keV in the heavy nuclei is introduced, and (iii) an averaged contribution from the electromagnetic spin-orbit interaction is used rather than the expected shell-model contribution. Justification for this averaging may be provided by amounts of not less than 15% of excitations into higher shell-model orbits for all nuclei. The Coulomb displacement energies of vibrational and rotational nuclei are observed to be smaller by up to 200 keV than corresponding spherical nuclei. Neutron halos have been calculated and are found to be in very good agreement with the results of Hartree–Fock calculations, the droplet model of Myers and Swiatecki and the calculations by Nolen and Schiffer using wave functions generated in a Woods–Saxon potential well. The calculated neutron halo for ^{208}Pb is 0.25 ± 0.05 fm. (auth)

16575 VARIATIONAL CALCULATION OF NUCLEAR MATTER. Pandharipande, V. R. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; A181: No. 1, 33-48(1972).

The lowest-order variational method with short-range correlations restricted to nearest neighbors is extended to treat the tensor force in nuclear matter. Calculations based on the soft-core Reid potential give −9.8 MeV binding energy per nucleon at equilibrium $k_F = 1.43$ fm^{-1}. The nuclear matter results from $k_F = 0.7$ to 1.8 fm^{-1} are in very close agreement with those of the Brueckner–Bethe calculations. (auth)

16576 THEORY OF HIGH ENERGY SCATTERING FROM NUCLEI. Skerry, Malcolm Alan. Boston; Boston Univ. (1972). 105p. University Microfilms Order No. 71-26,483.

Thesis.

Glauber's eikonal and multiple diffraction scattering theories are reviewed, and their relationship to other theories of high-energy scattering for multiparticle systems is indicated. Applying the multiple-scattering series to a Gaussian nuclear model a simple formula giving the dependence of the total nuclear cross section on the nuclear and nucleon parameters and on energy is derived. It is shown that a method of obtaining unique nuclear-model parameters is needed. Certain approximations basic to multiple diffraction theory are identified and used to derive an optical-model equivalent to the theory, and discuss its extension to large angle scattering. The multiple diffraction approximation is derived without using the eikonal two-particle scattering amplitudes. Approximate Green's functions are used to obtain potential-scattering amplitudes for small angle and large angle scattering. Sugar and Blankenbecler's expressions for scattering from a multi-particle system is simplified. (Diss. Abstr. Int., B)

16577 SINGLE-PARTICLE VIBRATIONAL INPUT STATES IN INTERACTIONS BETWEEN NEUTRONS AND NUCLEI. Popov, V. I. (Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 14-24(1971).

A single-particle vibrational intermediate-state model is employed for the analysis of interactions between low-energy neutrons and medium or heavy spherical nuclei. At neutron energies that are smaller than 1 MeV (i.e., at excitation energies of the compound nucleus <10 MeV), only quadrupole and octupole phonons will participate in the formation of the intermediate (or input) states. The energies of these phonons are known from experimental data on the positions of the first 2^+ and 3^+ levels of even–even spherical nuclei. Neutron force functions are calculated with a simple model by using a single-phonon excitation of the quadrupole or octupole type as the input states. Finally, the effects which single-particle vibrational input states have on radiative capture of low-energy neutrons are described. The results show that the intermediate-state model can provide a logical explanation of several effects that are observed in interactions between low-energy neutrons and complex nuclei and, hence, provide evidence for the validity of the intermediate state concept. (2 figures, 1 table) (R.W.R.)

16578 ROTATIONAL SINGLE-PARTICLE STATES OF DEFORMED ODD ATOMIC NUCLEI. Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 87-90(1971). (In Russian).

The presence of an "energy gap" in the spectrum of single-particle states of even–even nuclei facilitates the release of collective excitation which corresponds to the change in form of the surface of the nucleus and its rotation. In odd atomic nuclei the energies of single-particle and collective excitation are comparable. Their separation is possible, therefore, in some cases. Theoretical relations are brought forward and used to calculate values for spins and energies of the excited states of the ^{177}Hf nucleus. (K.S.W.)

16579 DIFFERENTIAL CROSS SECTIONS OF DIRECT NUCLEAR REACTIONS CORRESPONDING TO A RECTANGULAR DIAGRAM. Magzumov, E. Zh. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 14-21(Mar-Apr 1971). (In Russian).

Differential cross sections for the reactions (t,p) and (p,p') are described by rectangular diagrams with the aid of distorted waves. The dependence of the cross section on the energy of the incident particles is investigated. An estimate of the absolute values of the cross section is made, based on a simple "oscillatory" approximation with the help of a renormalization of the single-particle widths calculated from the experimental data of (d,p) and (t,d) reactions. (3 figures) (tr-auth)

16580 AVERAGE FIELD FOR QUASIPARTICLES IN NUCLEI. Vargadov, G. M.; Kalinkin, B. N. (Lebedev Inst. of Physics, Moscow. Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 9: No. 2, 240-51(Nov 1971). (In Russian).

The possibility of extracting the one-particle motion in nuclei is considered by methods of the theory of many-body systems. It is shown that the account of the nuclear polarization by an "outer" nucleon or a hole leads to the energy dependence of the average field. The properties of this field are considered. (auth)

16581 DWBA AND MITRA'S THREE-BODY MODEL OF STRIPPING. Bouldin, D.; Levin, F. S. (Brown Univ., Providence). Phys. Lett.; 37B: No. 2, 145-50(15 Nov 1971).

Mitra's three-body (separable potential) model of stripping is reexamined and new results are derived. In particular it is shown that a DWBA can be formulated for which the DWBA matrix element is identical to the exact stripping matrix element. A similar result is found to hold in the (many-body) case of nuclear reactions if the neutron–proton interaction V_{np} is of separable form. The three-body calculations of Reiner and Jaffe are used to show that the conventional DWBA matrix element is a good approximation to the exact (new DWBA) matrix element. The use of a product of two-body wave functions in DWBA to replace the three-body wave-function (neglect of deuteron internal distortion or "stretching") is thus justified on the basis of V_{np} being well approximated by a separable interaction. (auth)

16582 SIMPLE EXPLANATION OF ELASTIC SCATTERING OF HEAVY IONS. Dar, A.; Kirzon, Z. (Technion-Israel Inst. of Tech., Haifa). Phys. Lett.; 37B: No. 2, 166-9(15 Nov 1971).

The Glauber approximation for high energy particle-nucleus

scattering is generalized here to heavy ion elastic scattering above the Coulomb barrier. It is shown that the approximation (i) provides a well defined scheme for calculating elastic differential cross sections for heavy ion collisions which is free of the flexibility and ambiguities of both the optical model and the smooth cut-off diffraction models and (ii) provides a simple and accurate description of heavy ion elastic scattering in situations where nuclear exchange effects are either kinematically or dynamically suppressed. (auth)

16583 CALCULATION OF CROSS SECTION FOR COMPOUND-NUCLEUS FORMATION BY MEANS OF GENERALIZED S-MATRIX PARAMETERS. Gonchar, V. Yu.; Zheltonog, K. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 62-4(Mar-Apr 1971). (In Russian).

The cross section for formation of a compound nucleus by α particles was calculated by means of generalized parameters of the S matrix. Disagreement with the available experimental data did not exceed 5% for light and heavy nuclei at $E_\alpha = 40$ MeV. Agreement with experimental data was better than calculations using an optical model in this region. The simplicity of the former method also added merit. (1 figure) (tr-auth)

16584 COLLECTIVE MODEL OF ODD-ODD DEFORMED NUCLEI. Sharma, Shakti Dhara. Lawrence, Kan.; Univ. of Kansas (1971). 138p. University Microfilms Order No. 71-27,205.

Thesis.

A model of odd-odd nuclei, in which two odd nucleons are attached to a rotating core, is described. The Hamiltonian consists of H_R, the rotational part, H_p and H_n, the Hamiltonians for proton and neutron moving in harmonic oscillator potential wells with $\vec{l} \cdot \vec{s}$ and l^2 terms, V_{pn}, the residual neutron-proton interaction which has a Gaussian radial dependence with a Serber exchange mixture. The model is applied to all the main odd-odd nuclei whose energy spectra are experimentally known. The present investigation deals with all the main odd-odd nuclei on the basis of symmetric and asymmetric core models. The important feature of the model spectrum is found to be the constancy of basis in the symmetric core formulation which is shown to be related with core-rotation. The concept of state-gradient is introduced and the modification of the rotational features of the spectra by the particle states is explained in terms of state-gradient. The magnetic moments and quadrupole moments of ground states are calculated and compared with the experimental values, wherever possible. The general conclusions from this study are discussed and the suggestions for improvements are made in the concluding remarks. (Diss. Abstr. Int., B)

PHYSICS (PLASMA AND THERMONUCLEAR)

16585 (AED-C-12-23) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 12. NUCLEAR SCIENCE LITERATURE OF EASTERN COUNTRIES. NUMBER 23. PLASMAPHYSICS. Ensslen, Benno (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Sep 1971. 109p. (In German and English). Dep. NTIS (U. S. Sales Only).

This listing contains 1919 references on various aspects of plasma physics. (M.O.W.)

16586 (LA-4847) BALL LIGHTNING: A STATUS SUMMARY TO NOVEMBER 1971. Tuck, J. L. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 3p. Dep. NTIS.

Experiments to study ball lightning artificially are reported. Switch opening arcs at currents of up to 100,000 amperes from a large submarine storage battery (50 to 600 V) gave interesting but indecisive results. Higher-voltage (~10-kV) slowed-down condenser discharges were similarly indecisive, but had encouraging afterglows. Conjectures are made that: (a) the ball-lightning luminosity comes from a chemiluminescent reaction preceded by a chemi-ionization: (b) the ball-lightning coherence is a consequence of a weak surface force in a cold plasma containing positive ion–negative ion dipoles. The scope of further theoretical and experimental work to elucidate these conjectures is outlined. (auth)

16587 PLASMA PHYSICS INDEX. VOLUME 6, NO. 12, 1971. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 172p.

This listing contains 553 references on various aspects of plasma physics. (M.O.W.)

16588 REACTIONS UNDER PLASMA CONDITIONS. VOLUME II. Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971). 616p. $29.95.

Separate abstracts were prepared for four of the ten chapters, the remaining six chapters not being in scope for NSA. (M.O.W.)

For abstracts of individual chapters see: 16633, 16634, 16683, and 16713.

16589 PROGRESS IN HIGH-TEMPERATURE PHYSICS AND CHEMISTRY. VOLUME 3. Rouse, Carl A. (ed.). Elmsford, N. Y.; Pergamon Press, Inc. (1969). 332p. $14.00.

A separate abstract was prepared for one of the four included chapters. One chapter appeared previously in NSA as 24: 5158. The two chapters not in scope are: "A Review of Shock Tube Chemistry", by R. A. Strehlow, and "Exploding Wires and High-Temperature Chemistry", by M. J. Joncich. (M.O.W.)

For abstract of individual chapter see: 16620.

16590 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 5, NO. 11, 1971. Bibliography, Author Index, Subject Index, Appendix. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 52p.

This listing contains 278 references on various aspects of plasma physics and fusion reactors. (M.O.W.)

16591 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 5, NO. 12, 1971. Bibliography, Author Index, Subject Index, Appendix. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 54p.

This listing includes 274 references on various aspects of plasma physics and fusion reactors. (M.O.W.)

Confinement and Heating

16592 (LA-4852) RESONANT ABSORPTION OF LASER LIGHT BY PLASMA TARGETS. Freidberg, J. P.; Mitchell, R. W.; Morse, R. L.; Rudsinski, L. I. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 5p. Dep. NTIS.

It is proposed that a resonant mechanism should cause significant absorption of energy from intense laser pulses in plasma targets and, furthermore, that the energy should be deposited in such a way as to form a very non-Maxwellian high-temperature tail on the electron velocity distribution. (auth)

16593 (MATT-Trans-107) ENERGY BALANCE IN DEVICES OF THE TOKAMAK TYPE CONSIDERING CHARGE EXCHANGE. Dnestrovskii, Yu. N.; Kostomarov, D. P.; Pavlova, N. L. (Moscow State Univ. (USSR)). Translated for Plasma Physics Lab., Princeton Univ., N. J., from a Russian report. 52p. Dep. NTIS.

The energy balance in a toroidal plasma unit is calculated. Within the framework of a phenomenological description, a study is made of various models of the anomalous nature of plasma resistance and thermal conductivity. (auth)

16594 (NP-19160) MICROWAVE PLASMA HEATING EXPERIMENTS IN TUMAN-2 DEVICE. Golant, V. E.; Kaganskii, M. G.; Pakhomov, L. P.; Podushnikova, K. A.; Shakhovets, K. G. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1971. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

Microwave plasma heating experiments in the toroidal magnetic trap at the upper hybrid frequency range were carried out. At plasma concentration (1 to 3) $\times 10^{12}$ cm^{-3}, wave frequency of 9 GHz, and power of 80 kW, the microwave input efficiency determined from plasma parameters change runs up to dozens of percents. At concentration (1 to 2) $\times 10^{13}$ cm^{-3} and microwave frequency of 34 GHz, the energy input efficiency was 5 to 10%. The efficiency difference can be caused by influence of an evanescence region as the wave lengths were essentially less than the chamber dimension. (auth)

16595 (UCRL-Trans-10578) HIGH-POWER LASERS FOR HIGH-TEMPERATURE HEATING OF PLASMA. Kryukov, P. G.; Senatskii, Yu. V. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Moshchnye Lazery Vysokotemperaturnogo Nagreva Plazmy, Moscow, 1971. 25p. Dep. NTIS.

The main features of the design of high-power Nd glass lasers for the high-temperature heating of plasma are discussed. The use of laser radiation at the harmonic frequencies in heating experiments seems very interesting. Results show more than 50% efficiency of the Nd glass laser energy conversion into SHG. The use of SHG radiation has the following attractive features: it becomes possible to heat denser plasma, the laser-target feedback practically disappears, and the parameters of the laser pulse, in particular the contrast, are improved. (M.O.W.)

16596 (UCRL-Trans-10580) HIGH-POWER LASER UNIT WITH A SERIES-PARALLEL SYSTEM OF AMPLIFIERS FOR PLASMA HEATING. Basov, N. G.; Krokhin, O. N.; Sklizkov, G. V.; Fedotov, S. I.; Shikanov, A. S. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Preprint No. 123. 20p. Dep. NTIS.

A description is given of an experimental laser installation for the high-temperature heating of solid targets. This is done by a high-power neodymium-glass laser with pulse length adjustable in the range between 2 and 16 nsec and radiation energy between 600 and 1300 J. The light pulse is produced with the aid of an electro-optic shutter controlled by a laser-triggered discharge gap. The contrast of the radiation at the exit from the installation is about 10^{-7}. The radiation brightness is 3×10^{16} W/cm^2 · sterad. The mean flux density at the target reaches up to 10^{16} W/cm^2. It has been found that the maximum output energy of the laser decreases with decreasing pulse length. Preliminary experiments were carried out on the heating of a spherical polyethylene target. The heated-plasma diagnostics were based on the use of a system of ultrahigh-speed photography in the beam of a ruby laser. Measurements of the velocity of the spherical shock wave produced as a result of the expansion of the target in the gas were used to determine the energy absorbed by the plasma, which in these experiments amounted to 300 J for a pulse length of 2 nsec. (auth)

16597 ION COMPONENT PARAMETERS OF A PLASMA TURBULENT-HEATED BY A LONGITUDINAL FIELD IN A MIRROR MACHINE. Aranchuk, L. E.; Nedoseev, S. L. Zh. Eksp. Teor. Fiz.; 61: No. 5, 1856-63 (Nov 1971). (In Russian).

Results are presented of an experimental investigation of the efficiency of turbulent heating of ions by a current passing through a plasma along the magnetic field of a mirror machine. It is shown that the efficiency of plasma heating may reach 20%, most of the stored energy being in the ion component during the stage of confinement of the heated plasma in the trap. For a plasma concentration of 2×10^{13} cm^{-3}, the mean ion energy $\bar{\epsilon}_i \approx 3$ keV and the fraction of ions with energies lying in the range $0.5 \leq \epsilon_i \leq 20$ keV is about 30% of the total amount of ions. The ion lifetime is determined by charge exchange, with the neutral gas entering the plasma after turbulent heating, and is about 40 to 45 μsec. (auth)

16598 MULTIPLE-MIRROR CONFINEMENT OF PLASMAS. Logan, B. Grant; Lichtenberg, A. J.; Lieberman, M. A.; Makhijani, A. (Univ. of California, Berkeley). Phys. Rev. Lett.; 28: No. 3, 144-7(17 Jan 1972).

Multiple-mirror confinement of high-temperature plasma for fusion application is examined by numerical techniques using a fixed-scattering-center model. It is shown, in contrast to a linear relation found in an earlier study by Post, that the confinement time increases quadratically with the number of mirrors. The results of this scaling on the dimensions for a multiple-mirror reactor are presented. (auth)

16599 DYNAMIC EQUILIBRIUM OF A CURVED θ PINCH. Jones, Ieuan R. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Phys. Rev. Lett.; 28: No. 3, 135-8(17 Jan 1972).

Experiments with a curved θ pinch show that the application of an oscillating axial current suppresses the usual toroidal drift of the plasma column and allows a stable, dynamic equilibrium to be established. (auth)

16600 TWO-PLASMA GUN MAGNETIC FIELD LOADING METHOD. Hammel, Jay E. (to United States Atomic Energy Commission). U. S. Patent 3,624,443. 30 Nov 1971. Filed 31 Aug 1970.

A method is described for loading plasma into a containment device. Two plasma streams are directed into the containment geometry from opposite sides. The streams are offset from each other in the direction of the magnetic field so that their interaction causes the streams to stop within the containment geometry. (auth)

16601 EFFECTS OF AN ELECTROSTATIC TURBULENCE ON TRAPPED PARTICLES IN TOROIDAL PLASMAS. Dobrowolny, M.; Negrini, P. (Laboratori Gas Ionizzati, Rome). Phys. Rev. Lett.; 28: No. 3, 132-5(17 Jan 1972).

The effects of a weak electrostatic turbulence parallel to magnetic field lines on trapped particle motions in toroidal plasmas were studied. Possibilities of scattering of the trapped particles into the untrapped region of velocity space in the presence of ion sound turbulence are discussed. (auth)

16602 PLASMA EQUILIBRIUM IN A TOKAMAK. Mukhovatov, V. S.; Shafranov, V. D. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 11: No. 6, 605-33(Dec 1971).

Methods of maintaining a plasma in equilibrium with the help of a conducting casing, an external maintaining field, and the iron core of a transformer are discussed. Attention is paid to the role of the inhomogeneity of the maintaining field. It is shown how the shape of the column cross section depends on the curvature of the lines of force of the maintaining field. For the case (which has practical importance) of weak asymmetry of the field distribution in the transverse cross section, a uniform method of consideration is described that takes into account the influence of different factors on the equilibrium position of the column. This method is used for calculating plasma equilibrium in a tokamak model with a conducting casing. Account is also taken of the effects of gaps in the casing and of finite electric conductivity. Some cases of plasma equilibrium outside the standard tokamak scheme are also considered, such as equilibrium in a conducting shell having the shape of a racetrack, equilibrium where the whole current is transferred by relativistic runaway electrons, and equilibrium at high plasma pressure ($\beta_I \sim R/a$). (auth)

16603 DIRECT RE-INJECTION AS A SOLUTION TO THE MIRROR CONTAINMENT PROBLEM. Marcus, F. B.; Sweetman, D. R.; Cordey, J. G.; Chuyanov, V. A. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 11: No. 6, 661-4(Dec 1971).

A scheme is suggested in which particles emerging through the mirrors are neutralized and re-injected directly with high efficiency. A schematic arrangement for achieving this scheme is shown. Efficiency calculations are presented. (M.O.W.)

16604 TOROIDAL CONFIGURATION OF RELATIVISTIC ELECTRON BEAMS. Ikuta, Kazunari (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 32: No. 2, 497-9(Feb 1972).

The governing differential equation of the self-consistent relativistic neutralized electron beam is exhibited. A reasonable simple solution with spherical beam–vacuum interfaces is also given. (auth)

16605 MIRROR CONTAINMENT WITH LOW-FREQUENCY SHORT-WAVELENGTH FLUCTUATIONS. Aamodt, R. E. (Univ. of Colorado, Boulder). Phys. Fluids; 15: No. 3, 512-14(Mar 1972).

Low-frequency fluctuations with short wavelengths perpendicular to the magnetic mirror field are shown to only weakly affect particle containment. A critical fluctuation level is determined, below which no losses occur, and above which nonexpandable, nonlinear phase space transitions induce small losses. (auth)

16606 STEADY AXISYMMETRIC TOROIDAL EQUILIBRIUM IN IDEAL MAGNETOHYDRODYNAMICS. Asano, Naruyoshi; Taniuti, Tosiya (Nagoya Univ., Japan). Phys. Fluids; 15: No. 3, 423-34(Mar 1972).

A self-consistent theory of steady axisymmetric toroidal equilibrium in ideal magnetohydrodynamics with poloidal rotation about the magnetic axis and toroidal flow around the torus is described. An application of the characteristic theory of hyperbolic partial differential equations to the steady hydromagnetic equations yields critical rotational velocities (poloidal) for the formation of standing hydromagnetic waves, which depend on the direction of the wave normal. For low β and large aspect ratio, the critical velocities for the slow (magnetosonic) mode are, for any direction, nearly equal to a velocity found by Stringer for the onset of anomalous diffusion. Flows with poloidal motion about the critical slow velocities are investigated by analogy with nozzle flow in conventional gasdynamics, the distance along the axis of nozzle corresponding to the poloidal angle. The periodicity of entropy with respect to the poloidal angle excludes shock transitions and, as a result, trans-slow-magnetosonic flows. A class of continuous, self-consistent solutions in the standard tokamak ordering is obtained in terms of the expansion of the square root of the inverse aspect ratio, in which the poloidal flow approaches, at a point corresponding to the throat of nozzle, the critical slow velocity in the poloidal direction; the solutions are found to be approximated by continuous solutions in the usual low-β approximation which does not make use of Ampere's law. (auth)

16607 EXPERIMENTAL INVESTIGATIONS OF CONTAINMENT OF A HOT-ELECTRON PLASMA IN THE URAGAN STELLARATOR. Dikii, A. G.; Zalkind, V. M.; Zelenin, G. V.; (and others) (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 14: No. 6, 245-9(20 Sep 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 6, 366-9(20 Sep 1971).

Results are reported of an investigation of the containment of a hot-electron collisionless plasma in the Uragan stellarator with a steep helical winding. The shear was 0.1, and the angle of twist of the force line on the outer magnetic surface with average radius 6.8 cm was 1.7 π. The energy lifetime τ_E and the particle lifetime τ_n were determined over the T_e range 20 to 160 eV; two regions were observed, with a maximum at ~50 eV. The dependence on the discharge parameters and field intensity was studied. τ_E lies in the range of 5 to 6 τ_B, much less than τ_n (50 to 60 τ_B). The results are compared with data from the Saturn and Sirius stellarators. (D.L.C.)

16608 ION CYCLOTRON HEATING BY A TRANSVERSELY MODULATED ELECTRON BEAM. Yamamoto, Y.; Yatsui, K. (Osaka Univ.). Phys. Lett.; 38A: No. 2, 111-12(17 Jan 1972).

Excitation of ion cyclotron wave and associated heating of ions were experimentally investigated by a transversely modulated electron beam. The excited wave is found to be remarkably reduced at magnetic beach, together with the sharp peak of ion temperature. (auth)

Diagnostics

Refer also to abstracts 16081 and 16638.

16609 (EUR-CEA-FC-608) MEASUREMENT OF THE ELECTRON DENSITY OF A PLASMA IN A TOKAMAK-FAR REACTOR (TFR) USING A MICROWAVE INTERFEROMETER. Crenn, Jean-Pierre (European Atomic Energy Community. Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1971. 36p. (In French). Dep. NTIS (U. S. Sales Only).

Three types of interferometers were envisaged for measuring the electron density of a plasma in a Tokamak–Far reactor: a single channel interferometer with a mirror rotating at high speed, a multichannel interferometer with Fabry–Perot cavities, and a multichannel interferometer with electronic equipment allowing a zebra-stripe display of the interference fringes. This last device proved to be the most suitable. Its principal characteristics (working wavelength, number of channels, and electronics) are presented. (France)

16610 (IAE-2041) SEVERAL PROBLEMS IN MEASURING ION TEMPERATURES IN A TOKAMAK DEVICE. Sheglov, D. A. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Problems connected with the calculation of spatial distribution of ion temperature and certain other plasma parameters are

examined. Calculated profiles of spectral lines and theoretical charge-exchange spectra of neutral atoms are given for various types of ion temperature distribution. Results were obtained on the TM-3 device during simultaneous measurement of ion temperature by different methods (Doppler broadening and the charge exchange method). Neutral-atom spectra were computed in the presence of absorption in the plasma. Limiting ion temperatures were evaluated for Joule heating in the case where ion energy loss is connected only with charge exchange, and the length of free flight of an atom is small in comparison with plasma dimensions. (tr-auth)

16611 (IPP-2/202) PROPOSAL OF A NEW SCHEME USING EXTREME FORWARD LIGHT SCATTERING FOR ION TEMPERATURE MEASUREMENT IN STELLARATOR AND TOKAMAK PLASMAS. Gondhalekar, A.; Keilmann, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Aug 1971. 35p. (IPP-IV-26). Dep. NTIS (U. S. Sales Only).

Thomson scattering measurements were made at an angle of less than one degree. Using a CO_2 laser at $\lambda_0 = 10.6\ \mu$ ensures that $\alpha_s \gg 1$ in a stellarator or tokamak-type plasma. The scattered spectrum is then characteristic of the motion of the ions, and the ion temperature can be deduced from its width. Spectral resolution of the scattered light in the presence of direct light is made possible through a coherent photomixing receiver. Artificially enhanced "false light" serves as local oscillator radiation for the homodyne detection. A setup for measuring ion temperatures up to 1 keV at plasma densities down to 10^{12} cm^{-3} is described. (auth)

16612 (IYAF-57-70) DISTRIBUTION OF ELECTRON CONCENTRATION AND WAVE PROCESSES IN A PULSED DISCHARGE FROM LASER-SCHLIEREN MEASUREMENT DATA. Soloukhin, R. I.; Yakobi, Yu. A. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1970. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The dependence of electron concentration distribution on the cross sectional area of the discharge tube was studied in a direct discharge in argon, both during flow of the discharge current and during subsequent stages of the process. The schlieren method was used with a CO_2 laser as the source of light. A discharge tube, NaCl plate, BaF_2 lens, a rotating mirror, and a knife edge for intercepting the beam were supplementary to the operation. Data reported include the radial distribution of the electron concentration at the instant of initial maximum ionization, at a second maximum, and at the instant of initial minimum ionization. (K.S.W.)

16613 SPECTROSCOPIC PLASMA DIAGNOSTICS. Cabannes, F.; Chapelle, J. (CNRS, Orleans-La Source, France). pp 367-469 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

Conditions for the establishment of LTE and methods involving LTE are discussed in relation to the following: (1) absolute or relative measurements of the intensity of atomic lines, of molecular bands, and of the continuum, (2) absorption measurements: equivalent widths of lines and reversal of lines. Methods that can be applied to nonequilibrium plasmas, such as measurement of the emission and the absorption of the continuum and the study of line profiles, are also discussed. (139 references) (M.O.W.)

16614 MICROWAVE AND LASER DIAGNOSTICS OF PLASMAS. Ovsyannikov, A. (Institut Neftekhimicheskogo Sinteza, Moscow). pp 471-513 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are discussed: (1) plasma diagnostics with microwaves, (2) laser interferometry of plasmas, and (3) plasma diagnostics by means of laser light scattering. (179 references) (M.O.W.)

16615 PLASMA DIAGNOSTICS USING ELECTRICAL PROBES. Schott, Ludwig (Univ. of Saskatchewan, Saskatoon). pp 515-42 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

Some of the basic physical concepts of probe theory are described. The discussion covers collisionless and collision-dominated regimes along with double probes. Some experimental problems are also described. (53 references) (M.O.W.)

16616 ION MASS APECTROMETRY. Giraud, A. (CNET-GRI, Orleans-La Source, France). pp 543-77 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The physical principles underlying all the applications of mass spectrometric techniques to plasma analysis are reviewed. Experimental investigations of complex ionized gaseous media are surveyed, along with experiments designed to study specific reactions under various conditions. (153 references) (M.O.W.)

16617 SUBTRACTIVE MICROWAVE HOLOGRAPHY AND ITS APPLICATION TO PLASMA STUDIES. Iizuka, Keigo (Univ. of Toronto). Appl. Phys. Lett.; 20: No. 1, 27-9(1 Jan 1972).

A subtractive microwave-holographic technique is described. This technique appears to be novel in that it displays only the difference of the two dissimilar microwave fields. The effect is achieved by making use of the phase reversal that occurs when a contact print is made of the microwave hologram. The technique was demonstrated by subtracting the microwave image of a coin from that of three coins. To show the practicability of the technique, it was applied to the diagnosis of a plasma discharge. The fact that this method can eliminate the masking effects scattered by the glass envelope and its supports is a substantial improvement over other microwave diagnostic tools. (auth)

16618 PLASMA DIAGNOSTICS USING CO_2 LASER ABSORPTION AND INTERFEROMETRY. Offenberger, A. A.; Kerr, R. D.; Smy, P. R. (Univ. of Alberta, Edmonton). J. Appl. Phys.; 43: No. 2, 574-7(Feb 1972).

Absorption of CO_2 laser radiation was shown experimentally to be a useful plasma-diagnostic technique — spatially, temporally, and quantitatively. Electron densities determined from absorption agree well with shock-produced plasma values. Comparison of densities obtained via absorption, inteferometry, and Langmuir probes in a plasma jet also show good agreement in magnitude and spatial dependence. (auth)

16619 TRANSIENT PLASMA DIAGNOSTICS USING SIMULTANEOUS CO_2 LASER INTERFEROMETRY AND ABSORPTION. Offenberger, A. A.; Kerr, R. D. (Univ. of Alberta, Edmonton). J. Appl. Phys.; 43: No. 2, 354-6(Feb 1972).

The diagnostic technique described using simultaneous CO_2 laser interferometry and absorption, allows temporal determination of both electron density n_e and temperature T_e. Results are given for the case of a transient plasma produced by focusing TEA CO_2 laser radiation into argon. Application of these diagnostics to laser-produced plasmas provides a method for recombination coefficient measurements. Time dependence of average n_e and T_e along with a recombination coefficient for argon are reported. (auth)

16620 INTRODUCTION TO THE THEORY AND PRACTICE OF SPECTROSCOPIC DIAGNOSTICS OF HIGH-DENSITY PLASMA SOURCES OF AEROSPACE AND CHEMICAL SYNTHETIC INTEREST. Freeman, Mark P. (American Cyanamid Co., Stamford, Conn.). Progr. High Temp. Phys. Chem.; 3: 255-322 (1969).

The topics discussed in this chapter include the following: (1) spectroscopic measurement, (2) data acquisition, (3) data reduction, and (4) evaluation of a temperature profile. (M.O.W.)

16621 ION-TEMPERATURE-SENSITIVE EFFECT IN TRANSIENT LANGMUIR PROBE RESPONSE. Sanmartin, Juan R. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids; 15: No. 3, 391-401(Mar 1972).

A theory is presented for a method, recently proposed by Hester and Sonin, of determining the ion temperature in a plasma by measuring the transient current to a cylindrical Langmuir probe after applying a potential $V_p(-eV_p \gg \kappa T_e)$ under conditions where collection is collision free and the ratio of probe radius to Debye length is small. The ion component of the current does not approach its final steady-state value monotonically, but exhibits a strong, ion-temperature-dependent overshoot in the first few ion-plasma periods following the biasing of the probe. Analytical formulas are derived for the case of a Maxwellian plasma, and convenient graphical results are presented. The possible masking of the overshoot by a transient displacement current is discussed; it is shown how to avoid such displacement effects. For the overshoot to be sensitive to the ion temperature T_i, the probe must be near plasma (zero) potential before applying $V_p(eV_p^- < 0.1\ \kappa T_e, V_p^-$ being that initial potential); this is not a drawback of the method, but, on the contrary, it can be used to accurately determine plasma potential along with T_i. (auth)

16622 OPTICAL SWITCH FOR TRANSIENT PLASMA DIAGNOSTICS. McIntosh, R. E. (Univ. of Massachusetts, Amherst). Rev. Sci. Instrum.; 43: No. 2, 268-70(Feb 1972).

The photometric technique described facilitates the determination of the electron number density profile of a plasma generated by transient microwave pulses. (auth)

16623 ANALOG PLASMA DIAGNOSTIC SYSTEM. Nordlund, D. R. (Systems Research Labs., Inc., Dayton, Ohio); Breaux, O. P. Rev. Sci. Instrum.; 43: No. 2, 248-50(Feb 1972).

The simple electronic diagnostic system described provides a calibrated oscilloscope display of a Langmuir-probe I–V characteristic, its first and second derivative curves, the electron energy distribution function, and the "cumulative" electron number density. The system also provides a simple method for determining plasma potential and—if it exists—the electron temperature. Data taken in a low-temperature mercury discharge are compared with data taken by means of the well-known harmonic second-derivative technique. An electron number density of 4.9×10^{16} m^{-3} and an electron temperature of 9.7×10^3 K found with the new system compare very favorably to values of 4.7×10^{16} m^{-3} and 9.9×10^3 K determined from the harmonic second-derivative data. The system described features more rapid data reduction and lower cost than harmonic systems. (auth)

16624 SCHLIEREN–CINEMATOGRAPHIC AND HOLOGRAPHIC DIAGNOSTIC OF A LASER-PRODUCED PLASMA IN XENON. Hugenschmidt, M.; Vollrath, K.; Hirth, A. (Deutsch-Franzoesisches Forschungsinstitut, Saint-Louis, France). Appl. Opt.; 11: No. 2, 339-44(Feb 1972).

Gas breakdown in xenon was produced by a giant-pulse ruby laser with a power <100 MW. Detailed information concerning the structure of the laser plasma formation and of the following expansion was obtained by different optical methods, including schlieren techniques (single frames and ultrahigh-speed cinematography) and holography. The high quality of the holographic pictures was achieved by the use of a monomode laser. With this one was able to visualize the plasma history and to determine the velocities of the boundary layer and of the blast wave with utmost accuracy. Investigations of the electron density and electron temperature showed that a relaxation time of about 10 nsec is necessary to establish local thermodynamic equilibrium states. After this relaxation time, it is then possible to carry out thermodynamic calculations, applying the shock-wave theory, to relate the optically measured expansion velocity with the plasma parameters involved. The mean specific internal energy $\bar{\epsilon}$, for instance attained values in excess of 10^{12} erg/g, which decayed rapidly during the first 100 nsec to about 5×10^{10} erg/g. By comparing the results to theoretical calculations of $\bar{\epsilon}$, one obtained a first estimate of the temperature, taking into consideration the partial densities n_j as well as the partition functions $Z_j^{(i)}$ of the xenon atoms, the single-charged ions, and the double-charged ones. Furthermore, a two-step iteration computer program was used to give more detailed and more accurate results on the variations of the pressure, temperature, partial densities, and enthalpy as a function of time. (auth)

Kinetics (General)

Refer also to abstracts 15986 and 16107.

16625 (CEA-CR-1) MEETING ON FLAMES AND COLLISIONAL PLASMAS, SACLAY, FRANCE, NOVEMBER 30, 1970. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 126p. (In French). (CONF-701141).

Five papers were presented at the conference. Three of the papers deal with the chemical properties of flame plasmas; the other two are concerned with the chemical properties of cold plasmas. (M.O.W.)

16626 ROTATION DURING THE IMPLOSION OF A THETA PINCH. Benford, James (Univ. of California, San Diego, La Jolla). Phys. Fluids; 15: No. 3, 435-45(Mar 1972).

Measurements of fields and pressure gradients during the collapse of a theta pinch allow determination of the ion azimuthal velocity from the radial component of Ohm's law. In hydrogen and nitrogen discharges V_θ was found to change sign across the current sheet. Ions rotated so as to carry an appreciable fraction of the current in the front of the sheet and moved so as to oppose current flow in the rear. The total angular momentum was approximately zero. These results agree well with the Duechs calculations of the influence of small transverse fields. Measurements of small transverse fields in the current sheet are presented. (auth)

16627 REACTIONS UNDER PLASMA CONDITIONS. VOLUME I. Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971). 607p. $29.95.

A separate abstract was prepared for each of the ten chapters. (M.O.W.)

For abstracts of individual chapters see: 16613–16616, 16628, 16629, 16656, 16657, 16677, and 16678.

16628 PLASMA STATE. Venugopalan, M. (Western Illinois Univ., Macomb). pp 1-28 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are described: (1) high-temperature behavior of matter, (2) plasma, fourth state of matter, (3) plasmas, natural and man-made, (4) true plasma, (5) plasma in applied electric and magnetic fields, (6) radiation from plasmas, (7) theoretical approach in plasma studies, and (8) practical applications of plasmas. (48 references) (M.O.W.)

16629 FUNDAMENTAL DEFINITIONS AND RELATIONSHIPS PERTINENT TO PLASMAS. Shahin, Michael M. (Xerox Corp., Rochester, N. Y.). pp 29-52 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are briefly discussed: (1) elementary phenomena and concepts, (2) elastic collisions, (3) inelastic collisions, (4) mobility, (5) diffusion, (6) electron energy distribution, and (7) surface phenomena. (M.O.W.)

16630 AMBIPOLAR DIFFUSION IN A WEAKLY IONIZED UNSTABLE PLASMA AFTERGLOW. Ventrice, Carl A.; Brown, Charles E. (Tennessee Technological Univ., Cookeville). J. Appl. Phys.; 43: No. 2, 368-72(Feb 1972).

The afterglow of a weakly ionized plasma in the presence of a uniform axial magnetic field, varied from 0 to 900 G, was investigated. Evidence of enhanced diffusion associated with instabilities in the afterglow was observed. In those cases for which the afterglow is quiescent, the magnetic field dependence of the transverse ambipolar diffusion coefficient is in agreement with that predicted by classical diffusion theory. (auth)

16631 SOME RESULTS OF INVESTIGATIONS OF THE PHYSICS OF THERMO-EMISSION CONVERSION (A SURVEY). Karetnikov, D. V. pp 243-4 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

This brief survey indicates studies that were made at several institutes on the above subject. Results are summarized under the following topics: (1) diode plasma with high current density, (2) Knudsen regime, (3) transient phenomena, (4) stability of TEP over an extended surface, and (5) surface phenomena. (L.M.T.)

16632 COMPARISON OF THE PLASMA OF A THERMIONIC CONVERTER BETWEEN DIFFERENTLY COMPUTED ELECTRON DENSITIES AND MEASURED VALUES. Froelich, G.; Sewing, K. H. (Univ., Stuttgart). pp 285-90 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

In order to compute the electron densities in the cesium plasma of a converter and to compare these with the values obtained experimentally, the same parameters as used in previous publications and the measured profile of the temperature of the electrons are applied. Assuming local thermodynamic equilibrium for the calculations, too-high electron densities are obtained. Also, the peak of the curve of the measured electron densities with respect to the distance from the emitter does not agree with the corresponding peak for the Saha densities. The inclusion of diffusion in the calculations improves the results slightly. Therefore, the densities are computed by using rate equations for the several states of cesium whereby the collision, diffusion, and photo processes are taken into account. The resulting electron densities are also higher than the measured ones, but the difference is smaller than before. However, without photo-absorption the calculated densities are still higher than the measured ones. This means that the assumptions underlying the calculations have to be modified. A good agreement between the computations and measurements is achieved when it is taken into account that the fast electrons in the converter suffer a reduction in number in relation to the corresponding fast electrons of the Maxwellian distribution. Near the emitter the discrepancy of the Maxwellian distribution has to be greater than near the collector. (auth)

16633 PLASMA CHEMISTRY: AN INTRODUCTION. Venugopalan, M. (Western Illinois Univ., Macomb). pp 1-34 of Reactions Under Plasma Conditions. Vol. II. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are discussed: (1) definitions and principles, (2) low-temperature plasma chemistry, and (3) high-temperature plasma chemistry. (M.O.W.)

16634 ELEMENTARY REACTIONS IN LOW-TEMPERATURE PLASMA. Tal'rose, V. L.; Karachevtsev, G. V. (Inst. of

Chemical Physics, Moscow). pp 35-139 of Reactions Under Plasma Conditions. Vol. II. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are discussed: (1) general kinetic problems in plasma reactions, (2) electron impact formation of positive ions, (3) formation of negative ions by collisions of electrons with atoms and molecules, (4) excitation and dissociation of molecules and ions by electron impact, (5) formation of ions by collisions with excited and fast neutral species, (6) ion–molecule reactions involving positive ions, (7) ion–molecule reactions involving negative ions, (8) detachment of electrons from negative ions, (9) recombination of charged species, (10) vibrational relaxation reactions, (11) thermal dissociation of molecules, (12) recombination of neutrals, and (13) exchange reactions involving neutrals. (M.O.W.)

16635 CONCEPT OF EQUIVALENT PRESSURE IN DISCHARGE PLASMA IN E x H FIELDS. Gupta, D. R. (Univ. of Jodhpur, India). Indian J. Pure Appl. Phys.; 9: No. 8, 568-9 (Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

The behavior of plasmas in dc discharge in argon was studied in crossed electric and magnetic fields. The concept of "equivalent pressure" as proposed by M. A. Blevin and S. C. Haydon [Aust. J. Phys., 10: 18(1958)] was verified by measuring electron temperatures by the Langmuir probe method; fair agreement between the calculated and experimental T_e values was observed. (auth)

Kinetics (Experimental)

16636 (AD-731088) STUDY AND DEVELOPMENT OF HIGH-INTENSITY STOPPED-BEAM PLASMA SOURCES. Final Report, April 1–December 31, 1968. Graybill, S.; Uglum, J.; Rizzo, J.; McNeill, W.; Childers, K. (Ion Physics Corp., Burlington, Mass.). Jun 1968. Contract DA-49-146-XZ-553. 98p. (DASA-2315). NTIS.

The characteristics of the beam–plasma system generated by self-focused electron beams were studied. The effects of the plasma characteristics and drift-chamber geometry on propagation are discussed. Studies of the characteristic (line) x rays are described, as well as ultraviolet- and visible-region observations of the optical emission spectra in H_2, He, O_2 and Ar under typical beam entrance conditions of 40 kA at a mean energy of 1.5 MeV. The acceleration of light ions by the beam plasma system is demonstrated. Calculations are presented concerning the effect of the return current and the driving azimuthal magnetic field late in the pulse. (auth) (USGRDR)

16637 (AD-731533) STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS. Final Report, November 30, 1967–June 30, 1971. Oskam, Hendrik J. (Minnesota Univ., Minneapolis. Dept. of Electrical Engineering). Jul 1971. Contract F19628-68-C-0117. 22p. (AFCRL-71-407). NTIS.

Results obtained from studying the properties of decaying plasmas are summarized. The measuring method consisted of measuring the ion number density as well as the intensity of spectral lines and bands emitted by the plasma by mass-spectrometer and light-spectrometer techniques. The plasmas studied were produced in the rare gases, nitrogen, hydrogen, and mixtures of these gases. The occurrence of various collision processes involving charged particles was established and the relevant reaction rate constants were determined. The production of charged particles by mutual collision between metastable particles was studied. Unknown processes resulting in the emission of nitrogen bands were found. (auth) (USGRDR)

16638 BEHAVIOR OF He(2^3S) METASTABLE ATOMS IN WEAKLY IONIZED HELIUM PLASMAS. Miller, P. A.; Verdeyen, J. T.; Cherrington, B. E. (Univ. of Illinois, Urbana). Phys. Rev., A; 4: No. 2, 692-700(Aug 1971).

Investigations concerning the behavior of the He(2^3S) population in active-discharge and afterglow helium plasmas are described. Good quantitative agreement is obtained between measured He(2^3S) densities in active discharges and predicted values based on the solution of a nonlinear rate equation. The rate coefficient for ionizing triplet-metastable–metastable collisions is measured in afterglow helium plasmas for the pressure range 10 to 40 Torr; close agreement is obtained with the value reported by Phelps and Molnar, though consideration of effects due to electrons suggests a downward revision of about 20%. The electron temperature decay in the afterglow is measured and found to agree closely with the decay expected on the basis of calculated energy source and loss processes which affect the electron gas. In this work, measurement of the He(2^3S) metastable density is accomplished by the novel use of a He–Ne laser operating at 1.0798 μ in an interferometer as well as by the conventional optical-absorption method. Advantages and disadvantages of this interferometer technique are discussed. (auth)

16639 ION–MOLECULAR REACTIONS IN PLASMA CONTAINMENT DEVICES. Ripin, B. H.; Okabayashi, M.; Schmidt, J.; Voitsenja, V.; Yoshikawa, S. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Rev. Lett.; 28: No. 3, 138-42 (17 Jan 1972).

Ion–molecule charge exchange followed by dissociative electron recombination with molecular ions due to the presence of common impurities in a plasma-containment device was studied. For a He^+ plasma with N_2 impurity, the ionic constituency of plasmas is changed from He^+ to nitrogen ions with a time constant τ^* given by $\tau^*P(N_2) \simeq 24$ msec μtorr. However, those ion–molecular recombination processes are not responsible for the enhanced plasma loss in the Princeton spherator at the best vacuum condition. (auth)

16640 TRAPPING OF ELECTRONS IN LARGE-AMPLITUDE ELECTROSTATIC FIELDS RESULTING FROM BEAM–PLASMA INTERACTION. van Wakeren, J. H. A.; Hopman, H. J. (EURATOM–FOM, Amsterdam). Phys. Rev. Lett.; 28: No. 5, 295-8(31 Jan 1972).

Trapping of beam electrons was observed in the potential wells of large-amplitude electrostatic waves ($E = 7 \times 10^3$ V m^{-1}) resulting from beam–plasma interaction. Trapping is attended with the growth of a red-shifted sideband near the main peak in the frequency spectrum and with spatial oscillations in the amplitude of the main peak. (auth)

16641 INVESTIGATION OF PARAMETERS OF A HIGH-FREQUENCY DISCHARGE IN A MAGNETIC FIELD IN THE PRESENCE OF A GAS FLOW. Shuvalov, V. A.; Bass, V. P. (Inst. of Mechanics, Dnepropetrovsk, USSR). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 573-5(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 631-3(May-Jun 1971).

The effect of an external magnetic field on the parameters of a nonisothermal plasma generated by a plasmatron, with a coaxial system of brass electrodes cooled by water, was investigated. A hf (7 MHz) discharge in dry technically pure helium served as the plasma source. Plasma-potential distribution and charged-particle distribution measurements were made along the flow axis. Temperature distribution diagrams are also given. (M.O.W.)

16642 DISEQUILIBRIUM IN AN ARGON PLASMA JET FROM A HIGH-FREQUENCY INDUCTION DISCHARGE AT ATMOSPHERIC PRESSURE. Dresvin, S. V.; Klubnikin, V. S. (Leningrad Polytechnic Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 437-41(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 475-82(May-Jun 1971).

Gas and electron temperatures are reported for an argon plasma jet from an induction discharge at various levels of input power and gas flow rate. The gas temperature is measured by an enthalpy transducer and is found to be very much dependent on the latter parameters, whereas the electron temperature is hardly affected. The deviation from equilibrium is measured as a function of radial and longitudinal position. The plasma is in local thermodynamic equilibrium under a restricted range of conditions in restricted zones. The results are elucidated via calculations. (auth)

16643 EXPERIMENTAL OBSERVATION OF THE AMPLIFICATION OF LASER RADIATION IN THE INTERACTION OF COLLIDING LASER BEAMS IN A PLASMA. Kazakov, A. E.; Krasyuk, I. K.; Pashinin, P. P.; Prokhorov, A. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 7, 280-2(5 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 7, 416-18(5 Oct 1971).

The interaction of picosecond laser pulses in plasma was investigated. Varying beam intensities were used in the experiments. Spectrograms are given of the laser radiation before and after leaving the plasma. (M.O.W.)

16644 STRUCTURE OF A LASER-CHANNELED GAS-EMBEDDED z PINCH. Tidman, D. A. (Versar Inc., Springfield, Va.). Appl. Phys. Lett.; 20: No. 1, 23-5(1 Jan 1972).

The structure of a proposed several-mega-amperes discharge created along a narrow filament of laser-produced ionization through a high-density deuterium–tritium gas mixture is discussed. This initiation technique provides a convenient method for creating long straight gas-embedded z pinches (or screw

pinches if a B_z is included) which may be of thermonuclear interest. (auth)

16645 SPECTRAL INVESTIGATION OF LIGHT REFLECTED FROM A LASER-PRODUCED DEUTERIUM PLASMA. Buechl, K.; Eidmann, K.; Salzmann, H.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Appl. Phys. Lett.; 20: No. 1, 3-4(1 Jan 1972).

Plasma is created from solid deuterium targets by neodymium laser irradiation. The reflected laser light is shifted by 2.5 Å towards longer wavelengths. This is interpreted as a Doppler shift of the laser light reflected at a layer moving in the direction of the incident radiation with a velocity of 3.5×10^6 cm sec^{-1}. (auth)

16646 FLUCTUATION SPECTRUM OF PLASMA WITH FEW ELECTRONS IN DEBYE VOLUME OBSERVED BY COLLECTIVE LIGHT SCATTERING. Kato, M. (Univ. of Maryland, College Park). Phys. Fluids; 15: No. 3, 460-3(Mar 1972).

The validity of the usual light-scattering theory (i.e., $\Lambda \gg 1$) was verified for $\Lambda = 2$, where $\Lambda = N\lambda_D^3$ is the number of electrons in the Debye volume, N is the electron density, and λ_D is the Debye radius. Spectra of the light scattered from plasmas with $\Lambda = 2$ and 12 were measured and compared with the spectra predicted by $\Lambda \gg 1$ theory, with plasma parameters being independently obtained by the technique of plasma spectroscopy. Comparison between the plasma parameters ($n = 2$ to 3×10^{17} cm^{-3}, $T = 2$ to 6 eV) determined from scattered light and those deduced from spectroscopic measurement was also made. It was found that they agreed within the experimental errors. (auth)

16647 EXPERIMENTAL STUDY OF MAGNETO-VISCOUS EFFECTS IN A COMBUSTION PLASMA. Fussey, D. E. (Central Electricity Generating Board, Southampton, Eng.). J. Phys., D (London); 4: No. 12, 1913-28(Dec 1971).

In this experimental study, magneto-viscous interactions were produced in a combustion plasma by inserting a refractory plate into a rectangular duct flow. The experiments consisted of internal measurements of velocity distribution for both ordinary hydrodynamic flow and MHD flow (with a transverse magnetic field). Two configurations of the inserted plate were adopted: firstly, a plate long in the flow direction, but inserted only halfway across the duct; and secondly, a plate that extended across the full width of the duct, but that was semi-infinite in the flow direction. In each case the magnetic field was normal to the plate. In the MHD flows, the first plate configuration produced transverse wakes, emanating from the edge of the plate in the direction of the applied magnetic field. In the second configuration, where the developing boundary layer was investigated, the Hartmann effect was demonstrated. The experimental results are for flows in which the fluid properties are not uniform. They show the same trends as do theoretical solutions for similar configurations with uniform fluid properties. The magnitude of the interactions produced in this small-scale experiment suggests that highly significant magneto-viscous effects could be produced in large MHD generators that operate at much higher values of the Hartmann number. (auth)

16648 SOME PROPERTIES OF HYDROGEN PLASMA SPECTRA DUE TO CROSSING LEVELS. Varshalovich, D. A.; Fedorenko, V. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 30: No. 2, 206(Feb 1971).

Translated from Opt. Spektrosk.; 30: No. 2, 377-8(Feb 1971).

A spectroscopic method is proposed for determining the internal fields in a hydrogen plasma that is applicable to the case when the observed line widths considerably exceed the Zeeman splitting. Some measurements are briefly described. (M.O.W.)

16649 AUTO-IONIZING SERIES IN THE Al^{3+} ION SPECTRUM OF A LASER-PRODUCED PLASMA. Carillon, A.; Jamelot, G.; Sureau, A.; Jaegle, P. (Univ. Paris, Orsay, France). Phys. Lett.; 38A: No. 2, 91-2(17 Jan 1972).

The autoionizing transitions $2s^2\ 2p^6 - 2s\ 2p^6\ np$ were observed in the spectrum of Al^{3+} ions of a laser-produced plasma. It is suggested that they take a prominent part in the population inversions likely observed in the extreme uv range. (auth)

16650 ELECTRON-ION INTERACTION IN A WEAKLY IONIZED GAS. Gauthier, J.-C.; Sol, C. (Univ. Paris, Orsay, France). Phys. Lett.; 38A: No. 2, 125-6(17 Jan 1972).

The effective electron–ion collision frequency was measured in a weakly ionized gas. Results are in good agreement with classical theories for the electron–ion interaction in plasmas. (auth)

Kinetics (Theoretical)

Refer also to abstracts 15940 and 16847.

16651 (AD-731571) NONLINEAR FLUCTUATION-DISSIPATION THEOREM. Golden, K. I.; Kalman, G.; Silevitch, M. B. (Boston Coll., Chestnut Hill, Mass. Dept. of Physics). Jul 1971. Contract F19628-71-C-0078. 53p. (AFCRL-71-422). NTIS.

Using statistical mechanical perturbation theory, the second-order average current-density response is calculated for magnetic-field-free classical plasmas. A dynamical fluctuation–dissipation theorem is then derived, establishing a relationship between triplet microscopic current–current correlations and quadratic response functions; it also leads to a static fluctuation–dissipation theorem which provides a dielectric description of the equilibrium ternary correlation. A comparison of the latter with its expansion in terms of the Mayer pair correlation clusters is discussed. (USGRDR) (auth)

16652 (LA-4776) THEORETICAL EQUATION OF STATE FOR DEUTERIUM. Kerley, G. I. (Los Alamos Scientific Lab., N. Mex.). Jan 1972. Contract W-7405-eng-36. 28p. Dep. NTIS.

The thermodynamic properties of deuterium are calculated for densities ranging from 10^{-3} to 10^3 g/cm^3 and for temperatures ranging from 200 to 10^6 °K. Phase transitions between the molecular solid, metallic solid, and fluid phases are determined. Effects of dissociation and ionization are included in the fluid equation of state. Tabular results are presented for deuterium only, but approximate equations of state for hydrogen and tritium can be obtained by scaling the deuterium data. (auth)

16653 (NP-19173) SOLUTION OF A STATIONARY FOKKER-PLANCK EQUATION. Report No. 29. Leversen, Tore; Tjoetta, Jacqueline Naze (Bergen Univ. (Norway). Dept. of Applied Mathematics). Jun 1971. 20p. Dep. NTIS (U. S. Sales Only).

A stationary, linearized, and inhomogeneous Fokker–Planck equation describing the electrons of a weakly coupled and weakly inhomogenous plasma in a magnetic field, at times large compared to the effective electron–electron collision time, is solved. (auth)

16654 (SC-T-713087) NONLINEAR EFFECTS ON INTERACTION BETWEEN AN ULTRARELATIVISTIC ELECTRON BEAM AND A PLASMA. Breizman, B. N.; Ryutov, D. D.; Chebotaev, P. Z. Translated by Patricia Newman (Sandia Labs., Albuquerque, N. Mex.), from Conference on Plasma Theory, Kiev USSR, October 19–23, 1971. 28p. (CONF-711016-5). Dep. NTIS.

The problem of beam relaxation in a plasma is solved along with the energy given up by the beam per unit length of its path in the plasma. The change in state of the plasma due to beam heating and how this change affects relaxation are discussed. (M.O.W.)

16655 (SU-247-16) FINITE-DIFFERENCE PROGRAM FOR THE PREDICTION OF ARGON PLASMA TUBE FLOWS. Hunn, Bruce D. (Stanford Univ., Calif. Dept. of Mechanical Engineering). Jun 1971. Contract AT(04-3)-247. 69p. Dep. NTIS.

A finite-difference computer program was developed that predicts the local heat transfer and friction factor for a partially ionized argon plasma flowing inside a water-cooled round tube. The program includes temperature-dependent radiation sources inside the plasma, and incorporates a simple radiation model assuming a transparent gas. It was run for laminar flows using experimental entrance profiles of velocity and enthalpy taken from the published work of Schmidt (1969) and predicts the heat transfer behavior with reasonable accuracy. Qualification runs were made to establish the credibility of the present program. These included laminar constant and variable properties flows with both fully developed and developing temperature and velocity profiles. (auth)

16656 THERMODYNAMIC PROPERTIES OF THE EQUILIBRIUM AND NONEQUILIBRIUM STATES OF PLASMAS. Drawin, H. W. (CEN, Fontenay-aux-Roses, France). pp 53-238 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The fundamental properties of the photons and material particles are discussed on the basis of statistical mechanics for a system in complete thermodynamic equilibrium. The laws valid when a plasma is in local thermodynamic equilibrium are briefly treated. Nonequilibrium plasmas are studied, beginning with the fundamental equations by which a nonequilibrium state should be described and then treating several practical cases in detail. (328 references) (M.O.W.)

16657 TRANSPORT PROPERTIES OF PLASMAS. Drawin, H. W. (CEN, Fontenay-aux-Roses, France). pp 239-84 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

Transport properties associated with the transport of matter, momentum, energy, and electrical charges are considered. Transport coefficients are calculated on the basis of simplified gas-kinetic considerations and on the basis of a general treatment of the Boltzmann equation. 128 references. (M.O.W.)

16658 BEHAVIOR OF A PLASMA INTERACTING WITH THE COUNTER-ROTATING HIGH-FREQUENCY FIELDS OF A MULTIPOLE CONFIGURATION. Gutkin, T. I.; Lozovskii, S. N.; Boleslavskaya, G. I. (Physical-Technical Inst., Sukhumi, USSR). Nucl. Fusion; 11: No. 6, 591-5(Dec 1971).

The interaction of a plasma column in a constant magnetic field, H_z, with a system of two counter-rotating high-frequency magnetic fields whose axis of rotation is directed along a constant magnetic field is studied. Both the first and the second wave are uniform along the axis of rotation. The configuration of the high-frequency field is such that the electrical component of the field is directed along the constant magnetic field, while the latter does not influence the effectiveness of the action of the high-frequency field on the plasma. It is assumed that the collision frequency ν of the charged particles in the plasma is nonzero. Taking into account entrainment of the plasma by the high-frequency field, one can use, instead of the second wave of the alternating field, the constant magnetic field of a multipole configuration, which behaves as a high-frequency field relative to the rotating plasma. The distribution of the plasma rotation velocity v_φ, the charged-particle concentrations N, and the strength of the alternating fields $\tilde{H}_\varphi$ and $\tilde{H}_r$ along the plasma column radius are determined by a system of Maxwellian equations and equations of motion for the ions and electrons. A system of equations with boundary conditions is solved by computer, and the radial dependence of the angular velocity of rotation, the plasma concentration, and the high-frequency fields for different values of the multipole magnetic field and the plasma concentration are ascertained. If the ratio of the field strengths at the plasma boundary is of the order of unity, then the plasma column has a tubular structure. In the case of rotating plasma, the radial distribution of the high-frequency field is of a peculiar type. (auth)

16659 RADIATION LOSSES IN DENSE HIGH-TEMPERATURE HYDROGEN PLASMA CONTAINING IMPURITIES. Galushkin, Yu. I.; Kogan, V. I. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 11: No. 6, 597-604(Dec 1971).

The radiation intensity is calculated for a hydrogen plasma containing small amounts of impurity in the form of bare nuclei and hydrogen-, helium-, lithium- and beryllium-like ions with a nuclear charge Z in the range $5 \leq Z \leq 18$. Electron concentrations of $10^{16} \leq n_e \leq 10^{20}$ cm^{-3} and electron temperatures of $0.05 \leq kT/Z^2$ Ry ≤ 3 (Ry = 13.6 eV), which are typical of the radiating zone of the plasma focus, are considered. The results show, among other things, that the radiation from the impurities may substantially limit the lifetime of the high-temperature zone in the plasma focus. (auth)

16660 CALCULATION OF THE PARAMETERS OF AN OPTICALLY DENSE PLASMA OBTAINED BY A DISCHARGE WITH AN EVAPORATING WALL. Ogurtsova, N. N.; Podmoshenskii, I. V.; Rogovtsev, P. N. High Temp. (USSR) (Engl. Transl.); 9: No. 3, 430-6(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 468-74(May-Jun 1971).

Simple and convenient approximate equations relating the principal parameters (temperature and pressure) of the optically dense plasma obtained in a discharge with an evaporating wall to the current and the geometry of the discharge channel are derived. The analysis is carried out for quasi-steady-state conditions on the basis of ordinary gas dynamics, without allowing for the effects of magnetic forces. The calculated values of the parameters are in excellent agreement with experiment over a wide range of temperatures and pressures and may prove useful in choosing the optimum working conditions for a discharge of different geometry and energy. (auth)

16661 OPTICAL TRANSMISSION OF A NONEQUILIBRIUM PLASMA. Preobrazhenskii, N. G.; Sharapova, T. A. (Novosibirsk State Univ., USSR). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 449-52(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 493-6(May-Jun 1971).

A method is presented for estimating the optical transmission of an inhomogeneous plasma if the integral transmission criterion is known for the plasma of a Boltzmann radiator. The results are presented as a set of curves for various line shapes and degrees of strictness of the initial criterion as functions of the deviation from equilibrium. The method is illustrated for a hot hydrogen plasma and a cool barium plasma in a Q machine. (auth)

16662 FAST PARTICLES IN A PARAMETRICALLY UNSTABLE PLASMA. Pustovalov, V. V.; Silin, V. P. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 14: No. 7, 299-301(5 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 7, 439-41(5 Oct 1971).

The formation of fast particles is studied, considering the fact that the experimental study of the reaction of high-power radiation on the plasma has come to be accompanied frequently with measurement of the particle velocity distribution. The appearance of such particles in such experiments as Cherenkov interaction of waves with particles is discussed. (M.O.W.)

16663 THEORY OF AN EQUILIBRIUM HIGH FREQUENCY GAS DISCHARGE. Meierovich, B. E. (Physical Lab., Moscow). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1891-1905(Nov 1971). (In Russian).

The theory of an equilibrium high-frequency gas discharge in a cylindrical cavity (waveguide) is developed without imposing any restrictions on the penetration depth of the field in the normal skin effect. The structure of the discharge is studied and equations are obtained that determine the dependence of the discharge parameters on input power. A dependence of the maximal temperature in a hydrogen discharge at atmospheric pressure on input power is found that explains the presence of two types of discharge in diatomic gases, viz., the diffuse and column discharges. The experimental dependence of discharge current on power, observed by Kapitza and Filimonov, differs from that calculated theoretically under the assumption of local thermodynamic equilibrium. A theory of an equilibrium high-frequency discharge in a gas flow is developed under the assumption of a strong skin effect. The dependence of plasma temperature in a discharge on input power and gas flow velocity is found. The one-dimensional problem of a plane stationary discharge in a given gas flow is solved; this can be applied to plasmatrons with helical gas flows. The problem of free propagation of a discharge front, similar to the problem of flame propagation during slow combustion, is also solved. (auth)

16664 FORMULATION OF BINARY INELASTIC COLLISION INTEGRALS. Claassen, H. A. (Kernforschungsanlage, Juelich, Ger.). pp 343-50 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Starting from the Boltzmann equation, a set of moment equations for the components of a partially ionized stationary gas mixture is derived taking into account binary inelastic collision processes. In the procedure adopted, all internal states of a specific particle species (neutrals, ions, electrons) are treated as separate components of the mixture. The distribution functions are expanded in velocity space, leaving the determination of the distribution over internal energy states to the solution of the rate equations. Assuming small deviations from translational equilibrium and the validity of the hydrostatic pressure approximation, Grad's 8-moment approach is used. The collision integrals are transformed in the usual way with the aid of a generalized microscopic reversibility relation, assuming axial symmetry of the differential cross sections. Specific simplifications result in combining the contributions of all internal states of any particle species. By introduction of individual translational temperatures for the particle species, electron temperature elevations under the action of electric fields are allowed for. The collision integrals are presented in terms of modified Chapman–Cowling integrals, depending on a parameter that characterizes the inelastic energy loss. Considering excitation of Cs atoms by electron impact, those Chapman–Cowling integrals involving total cross sections are numerically calculated on the basis of Gryzinski's theory. (auth)

16665 ANOMALOUS HIGH-FREQUENCY RESISTIVITY OF A PLASMA. Kruer, W. L.; Dawson, J. M. (Princeton Univ., N. J.). Phys. Fluids; 15: No. 3, 446-53(Mar 1972).

In one- and two-dimensional computer simulations, an anomalous high-frequency resistivity in a plasma driven by a large electric field oscillating near the electron plasma frequency is investigated. The large field excites the oscillating two-stream and the ion-acoustic decay instabilities, in agreement with the linear theory. When the ion and electron fluctuations saturate, a strong anomalous heating of the plasma sets in. This strong heating is due to an efficient coupling of the externally imposed large electric field to the plasma by ion fluctuations. The anomalous collision frequency and the saturation fluctuation amplitudes are determined as a function of the external field amplitude and frequency, and the electron–ion mass ratio. A simple nonlinear theory gives results in reasonable agreement with simulations. (auth)

16666 INTERACTION OF A HIGHLY ENERGETIC ELECTRON BEAM WITH A DENSE PLASMA. Kainer, Selig (Naval Research Lab., Washington, D. C.); Dawson, John; Shanny, Ramy; Coffey, Timothy. Phys. Fluids; 15: No. 3, 493-501(Mar 1972).

The interaction of an electron beam with a relatively dense background plasma was examined through numerical experiments,

where the beam velocity is much greater than the thermal velocities. It is shown that the initial growth of the unstable waves is described by the two-stream instability and that the phenomena can be separated into two regions, (high and low density) depending on whether or not merging of space-averaged velocity distributions occurs during the growth of the initially most unstable wave. The occurrence of these regions is shown to follow from energy and momentum considerations. The long-time behavior of the low-density regime, where the merging does not take place during the initial growth of the instability is shown to be described quite well by quasi-linear theory. (auth)

16667 MODIFIED SCHOTTKY BOUNDARY CONDITION IN A WIDE PLASMA COLUMN. Ventrice, Carl A. (Tennessee Technological Univ., Cooksville). Phys. Fluids; 15: No. 3, 510-12(Mar 1972).

Axial current density measurements are made in a wide argon magnetoplasma. From these measurements, a "modified Schottky" boundary condition is found to apply. (auth)

16668 APPEARANCE OF A CURRENT (NEUTRAL) SHEET IN A PLASMA MOVING IN THE FIELD OF A TWO-DIMENSIONAL MAGNETIC DIPOLE. Somov, B. V.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1864-76(Nov 1971). (In Russian).

The two-dimensional problem of stretching out a dipole magnetic field by a plasma flow is considered in the strong-magnetic-field approximation. It is assumed that the magnetic dipole field is initially frozen in the plasma and the region is bounded by a uniformly expanding cylindrical surface on which the magnetic flux is retained. It is shown that doubling of the boundary surface radius results in a neutral point appearing at the region boundary; on further expansion, the neutral point produces a current (neutral) sheet. The problem may be regarded as a simplified model of the mechanism of formation of the Earth's magnetic tail and of solar coronal streamers or helmet structures. (auth)

16669 CHERENKOV TYPE OF RADIATION IN AN ANISOTROPIC ELECTRON PLASMA. Khan, R. M. (City Coll., Calcutta). Indian J. Phys.; 44: No. 7, 392-8(Jul 1970).

An exact solution for the electromagnetic field due to a moving line charge through an anisotropic electron plasma in the presence of an external magnetic field is given. Electromagnetic intensities and radiation are slowly damped due to collision of electrons, but the attenuation is very intensive within a certain range of frequency. The wave propagation is mainly transverse to the dc magnetic field and there exists other types of radiation along with the Cherenkov radiation. (auth)

16670 DIELECTRIC FUNCTION OF DEGENERATE PLASMA AT RELATIVISTIC TEMPERATURES. Misra, P.; Roy, K. C. (Ravenshaw Coll., Cuttack, India). Indian J. Phys.; 44: No. 7, 399-404(Jul 1970).

Expressions for the transverse and longitudinal dielectric functions of a degenerate plasma are obtained at relativistic temperatures. The nature of wave propagation is discussed and results compared to those obtained for a degenerate plasma at nonrelativistic temperatures (Misra et al 1962, 1970). (auth)

16671 ASYMPTOTIC SOLUTION OF THE FRIEMAN AND BOOK EQUATION FOR THE PAIR-CORRELATION FUNCTION. Devanathan, R. (Indian Inst. of Science, Bangalore). Physica; 57: No. 1, 133-40(1 Jan 1972).

Using Thomé's procedure, the asymptotic solutions of the Frieman and Book equation for the two-particle correlation in a plasma are obtained in a complete form. The solution is interpreted in terms of the Lorentz distance. The exact expressions for the internal energy and pressure are evaluated, and they are found to be a generalization of the result obtained earlier by others. (auth)

16672 NONLINEAR THEORY OF BROADENING OF LOW-FREQUENCY SPECTRA OF MAGNETOPLASMAS. Weinstock, J. (Aeronomy Lab., Boulder, Colo.). Phys. Lett.; 38A: No. 2, 127-8(17 Jan 1972).

A nonlinear theory is described for the marked spectral broadening observed for low-frequency waves. This theory is based on the frequency degeneracy of such waves. This degeneracy is split by nonlinearities, and this frequency splitting leads to broadening, consistent with some experiments. (auth)

16673 RECOMBINATION OF Cs ELECTRONS AND IONS BY COLLISIONAL AND RADIATIVE PROCESSES. Sayer, Bernard; Pascale, Jean (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 273: No. 12, 453-5(20 Sep 1971). (In French).

The coefficient of collisional radiative recombination for electrons and ions is calculated using a statistical model. An analytic expression is given for this coefficient in terms of the electron density and temperature. (France)

16674 FUNDAMENTAL EQUATIONS FOR THE INTERACTING SYSTEM OF HIGH-INTENSITY LASER PULSE AND GAS PLASMA. Goto, S. (Tokyo Gakugei Univ.). Lett. Nuovo Cim.; 2: No. 23, 1207-13(4 Dec 1971).

The total Hamiltonian for a fully ionized plasma is stated. The various modes of the system are described. In order to investigate the energy exchange between particles and/or quasi particles, the basic equations are derived to follow the time change of the number of these particles and quasi particles having specified momenta by using the second-quantization formalism. (M.O.W.)

Production

Refer also to abstracts 16145 and 16719.

16675 (AD-731291) DETERMINATION OF SPATIAL AND TEMPORAL ELECTRON DENSITY AND TEMPORAL ELECTRON TEMPERATURE IN LASER-PRODUCED GASEOUS DEUTERIUM PLASMAS. Technical Report, January 1, 1970-April 30, 1971. Pendleton III, Winston K. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Sep 1971. 101p. (AFWL-TR-71-71). NTIS.

The temporal and spatial electron density distribution and the temporal variation of electron temperature were determined in gaseous deuterium plasmas produced by a laser. In addition to these measurements, made during laser irradiation of the plasma, the plasma growth rate, laser-plasma absorption and reflection interaction, and pressure dependence of laser intensity breakdown threshold were determined. A time-variable reflectivity ruby laser with a pulse duration of 4 nsec was employed in these experiments at gas pressures from 100 to 600 torr. The electron density and temperature measurements represent a major addition to the data available on laser-produced plasmas. (auth) (USGRDR)

16676 (AD-731373) DEMONSTRATION OF COLLISIONLESS INTERACTIONS BETWEEN COUNTERSTREAMING IONS IN A LASER-PRODUCED PLASMA EXPERIMENT. Final Report. Dean, Stephen O. (Naval Research Lab., Washington, D. C.). 17 Sep 1971. 47p. (NRL-7301). NTIS.

The width, time development, and ambient pressure dependence of a collisionless interaction front in a plasma were studied with fast photography, shadowgraphy, and electric potential probes. The object was to investigate the expansion of a laser-produced plasma through an ambient plasma, under conditions where the mean free path for binary momentum transfer collisions was larger than the total expansion radius. Sharp luminous fronts were observed with both framing and streak photography. The change in plasma radius with time was studied as a function of ambient nitrogen pressure. The dynamics of the situation were in good agreement with strong-momentum-coupling models (a radiation-driven detonation wave at early times, and a blast wave at later times). An electric potential in the front was measured, of sufficient magnitude to account for the observed late-time blast wave energies. Shadowgraphy showed that the front consisted of a shell of enhanced density, that the density gradients in the front depended on ambient pressure, and that the front width was of the order of a millimeter. A possible theoretical model for the collective effect necessary to account for the observed collisionless dissipation is the ion-ion two-stream instability in the presence of a magnetic field. (auth) (USGRDR)

16677 ELECTRICAL-DISCHARGE PLASMAS. Shahin, Michael M. (Xerox Corp., Rochester, N. Y.). pp 285-328 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The discussion is included under the following broad topics: (1) electrical breakdown in gases, (2) corona discharge, (3) glow discharges, (4) electric arcs, (5) hf electrical discharges in gases, and (6) experimental techniques for production of electrical discharges. 51 references. (M.O.W.)

16678 PLASMAS OTHER THAN ELECTRICAL DISCHARGES. Venugopalan, M. (Western Illinois Univ., Macomb). pp 329-65 of Reactions Under Plasma Conditions. Vol. I. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

Some of the most important methods for plasma production, other than electric discharge, are briefly discussed, namely: (1) thermal methods, (2) shock wave methods, (3) chemical reactions of high specific energy, (4) nuclear reactions, (5) irradiation by high-energy photons, gamma rays, or alpha particles. 112 references. (M.O.W.)

16679 NUCLEAR FUSION BY LASER RADIATION. Floux, F. (CEA-CEN de Limeil, Villeneuve-Saint-Georges, France). Nucl. Fusion; 11: No. 6, 635-47(Dec 1971).

After briefly recalling the main features of laser-produced plasmas and the problems involved in the production of nuclear D–D reactions, fundamental data on heating mechanisms are presented. Experimental results and heating limitations are then presented. Finally, a review of present and future possibilities of both laser and plasma parameters is given. (auth)

16680 USE OF AN ELECTRIC-DISCHARGE SHOCK TUBE TO OBTAIN A NONIDEAL PLASMA. Lomakin, B. N.; Fortov, V. E.; Shchekotov, O. E. (Moscow Physical-Technical Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 570-2(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 628-31(May-Jun 1971).

Diagrams are given that show the degree of imperfection and degree of ionization in the forward and reflected shock waves. The relative fall in pressure in the forward and reflected shock waves is discussed. Calculations showed that it is possible to obtain high degrees of ionization, while still leaving considerable corrections to the thermodynamic functions. (M.O.W.)

16681 QUASI-STATIONARY PLASMA PRODUCED BY CURRENT PULSES IN NITROGEN AND ARGON. Malkin, O. A.; Pyshnov, A. V. (Moscow Engineering Physics Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 576-7(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 633-5(May-Jun 1971).

Nitrogen plasma was produced by a rectangular current pulse in a quartz tube 30 mm in diameter and 190 mm long, with flat aluminum electrodes at the ends. Diagrams are given of energy-level populations and radial distributions of temperature and electron density in the discharge. (M.O.W.)

16682 IONIZATION OF A BACKGROUND GAS BY A WEAK ($\nu/\gamma \ll 1$) RELATIVISTIC ELECTRON BEAM. Swain, David W. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 396-405 (Feb 1972).

The injection of a relativistic electron beam into a neutral gas creates a background plasma. A simple model is presented for this process, which includes (a) direct ionization of the gas by the high-energy electrons and (b) ionization of the gas caused by the acceleration of secondary electrons in the axial electric field of the beam. A self-consistent calculation of the conductivity and the electric field in the beam is carried out. The predictions of the model are compared with an experiment on a 2-MeV 4-kA beam of 100-nsec duration, injected into helium at 0.2 to 2.0 torr. Results indicate that the theory agrees with experimental observations at lower pressures, but tends to deviate from experimental values at higher pressures. (auth)

16683 CHEMICAL REACTIONS IN PLASMAS OBTAINED BY IRRADIATION WITH ELECTROMAGNETIC RADIATIONS AND BY BOMBARDMENT WITH HIGH-ENERGY PARTICLES. Venugopalan, M. (Western Illinois Univ., Macomb). pp 431-507 of Reactions Under Plasma Conditions. Vol. II. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

The following topics are discussed: (1) plasmas obtained by photon irradiation, (2) ionized media obtained in radiolytic systems, (3) ionized gases obtained by particle bombardment, and (4) space plasmas. (M.O.W.)

16684 PHOTOIONIZATION OF METASTABLE ATOMS OF BARIUM. Ishii, S.; Ohlendorf, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 38A: No. 2, 119-20(17 Jan 1972).

Photoionization of barium atoms in metastable states is experimentally studied. A production rate of 8×10^{11} ions/cm^2 sec is obtained, and the ionization efficiency amounts to 0.02%. The experimental value is about three times as large as the predicted value, based on a theoretical calculation of the photoionization cross section of metastable barium. It is proved that photoionization of the metastable atoms is the main process for ion production in the experiment. (auth)

16685 INITIAL STAGE OF EXPANSION OF PLASMA CONTAINED IN A HEAVY COATING ACTED ON BY A LASER IMPULSE. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 19: No. 7-8, 601-9(1971).

The problem of expansion of a plasma contained in a heavy coating and subjected to a strong laser impulse is considered, at the initial stage of the expansion process, on the basis of the averaged description. For this stage of the process it is assumed that the intensity of light is proportional to the maximum sectional area of the spherical plasma body. By linearizing the problem in an appropriate manner, expressions of r(t) and T(t) are obtained for the initial stage of expansion. It is shown that for systems with a heavy coating, the geometry of the plasma body and the form of the impulse are essential at the initial stage of expansion (10^{-10} to 10^{-9} sec). For the description of further phases of the expansion process, the value of the energy of the impulse is essential. For times near 5×10^{-9} sec to 10^{-8} sec, this impulse may be assumed (for the averaged description) to be of the Dirac type. (auth)

Stability

16686 (EUR-CEA-FC-607) CORRELATION STUDY OF DRIFT INSTABILITIES IN A COLLISIONLESS PLASMA. Boissier, R. (European Atomic Energy Community, Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Sep 1971. 56p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

Collisionless drift instabilities due to the pressure gradient occurring in a plasma confined by a uniform magnetic field were experimentally studied. Spectral analysis correlation methods were used. The electronic equipment is described and the numerical Fourier treatment of the inter- and self-correlation is presented. The measurements performed with a real-time multichannel correlator with a 10-MHz pass band are presented. These measurements contributed to the precise identification of drift waves spontaneously occurring in the collisionless plasma of the ODE experimental device. (France)

16687 (IPP-1/123) ROTATIONAL INSTABILITIES AND AXIAL CURRENTS IN THE THETA PINCH ISAR I. Kaufmann, M.; Fuenfer, E.; Junker, J.; Neuhauser, J.; Seidel, U. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Oct 1971. 26p. Dep. NTIS (U. S. Sales Only).

Rotation of the plasma column and rotational instabilities were studied in the ISAR I linear theta pinch, using two coils with a length of 1.5 and 5.4 m, respectively ($T_e \leq 450$ eV, $E_i \leq 4.5$ keV, and $n_e \sim 10^{16}$ cm^{-3}). A possible mechanism that can cause plasma rotation is short-circuiting of the radial electric Hall field over the ends of the linear pinch. The axial short-circuit current predicted by this model could, in fact, be measured by measuring its magnetic field. The sign of this current and the total charge of the current pulse were in agreement with this model. The duration of the current pulse was about equal to the transit time of a torsional Alfvén wave over half the coil. These results justify the assumption that the plasma rotation in open-ended theta pinches is essentially caused by end effects and should, therefore, be of minor importance for toroidal pinches. (auth)

16688 (NP-19167) REPRESENTATION OF GROWTH OF PLASMA TURBULENCE. Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1971. 70p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental and theoretical work on plasma turbulence is surveyed. Turbulent collisions, turbulent states of matter, and comparisons with turbulence of incompressible liquids are presented. Statistical descriptions of plasma turbulence, averaging, stochastic potential, and nonlinear scattering and stochastic heating of plasma are treated. Other topics of interest include the effective turbulent collisions of particles and waves, irreversibility in the theory of plasma turbulence, and turbulent broadening of resonances of nonlinear decay interaction. 74 references. (K.S.W.)

16689 (ORNL-TM-3675) NONLINEAR STABILIZATION OF SINGLE, RESONANT, LOSS-CONE FLUTE INSTABILITIES. Crume, E. C.; Meier, H. K.; Eldridge, O. C. (Oak Ridge National Lab., Tenn.). Jan 1972. 39p. Dep. NTIS.

The evolution of linearly unstable, high-frequency ($\omega \approx n\Omega$), flute-like ($k_{||} = 0$) electrostatic modes that can occur in a multicomponent, magnetic-mirror-confined collisionless plasma is studied by computer simulation. An infinite, periodic, sheet charge model was used in which particle motion is followed in one spatial coordinate and two velocity coordinates normal to a constant magnetic field. Approximately one quarter of the particles in the initial velocity distributions formed a warm, Maxwellian background component; the remainder belonged to a hot, linearly stable, loss-cone component. These velocity distributions were constructed in such a way as to provide initial states relatively free of randomly fluctuating electric fields. The early evolution of single-wave (either traveling or standing), resonant instabilities agrees well with

linear theory. A rapid, coherent heating of the warm component occurs, and spatial harmonics of the unstable wave appear. The electrostatic field of the wave then saturates at an energy level as much as two orders of magnitude lower than those reported in previous simulation studies of the same and related instabilities or predicted from earlier nonlinear analysis. The field amplitude decreases rapidly to zero after saturation and then grows again nonlinearly. The temperature of the warm component reaches a maximum when the field amplitude vanishes. During and subsequent to this nonlinear growth period, details of the evolution of the field amplitude vary from case to case. The saturation levels and early post-saturation behavior are in agreement with a recently reported nonlinear analysis motivated by the results reported here. (auth)

16690 PARAMETRIC INSTABILITY OF PLASMA WAVES IN A MAGNETIC FIELD, DUE TO HIGH-FREQUENCY ELECTRIC FIELDS. Chang, R. P. H.; Porkolab, M.; Grek, B. (Princeton Univ., N. J.). Phys. Rev. Lett.; 28: No. 4, 206-9(24 Jan 1972).

The parametric excitation of ion acoustic waves and cyclotron harmonic waves by a high-frequency electric field with frequencies near the harmonics of the cyclotron frequency was observed. Both the wave-vector and the frequency selection rules were verified. The measured threshold fields and growth rates are in good agreement with theory. (auth)

16691 MODULATIONAL INSTABILITIES DUE TO TRAPPED ELECTRONS. Dewar, R. L. (Princeton Univ., N. J.); Kruer, W. L.; Manheimer, Wallace M. Phys. Rev. Lett.; 28: No. 4, 215-17(24 Jan 1972).

As a simple model for investigating the stability of an electrostatic plasma wave with trapped electrons, the plasma is regarded as a nonlinear, dispersive dielectric. A nonlinear Schroedinger-type equation is found, which predicts instability for both electron plasma waves and ion acoustic waves. These instabilities do not depend on resonance with the bouncing motions of the trapped electrons, and thus have a different physical origin than those predicted by bunched-beam models. (auth)

16692 SPECTRUM AND ANOMALOUS RESISTIVITY FOR THE SATURATED PARAMETRIC INSTABILITY. DuBois, D. F. (Hughes Research Labs., Malibu, Calif.); Goldman, M. V. Phys. Rev. Lett.; 28: No. 4, 218-21(24 Jan 1972).

A wave spectrum peaked in angle and broadened in wave number is found from a nonlinear saturation theory for the decay-type parametric instability in the case of nearly equal electron and ion temperatures. The dominant saturation mechanism is nonlinear damping of Langmuir waves by induced scattering from ions. The nonlinear resistivity for transverse waves, including the pump, is obtained from the related mechanism of conversion of transverse into longitudinal waves due to interaction with ions. (auth)

16693 THRESHOLD AND SATURATION OF THE PARAMETRIC DECAY INSTABILITY. Stenzel, R.; Wong, A. Y. (Univ. of California, Los Angeles). Phys. Rev. Lett.; 28: No. 5, 274-7(31 Jan 1972).

Observation of the time development of parametric instability reveals new oscillatory saturation states, whose frequency is proportional to the pump intensity. The self-consistent pump field simultaneously exhibits similar but 180° out-of-phase oscillations. Application of a small auxiliary driver wave ($E_t \sim 0.1\ E_0$) at the electron sideband lowers the threshold and dramatically enhances the intensity of excited ion wave. Growth rate and functional dependence of threshold on ion damping are verified. (auth)

16694 PARAMETRIC SUPPRESSION OF A LARGE-AMPLITUDE PLASMA INSTABILITY. Decker, J. F. (Bell Telephone Labs., Whippany, N. J.); Levine, A. M. Phys. Rev. Lett.; 28: No. 5, 286-9(31 Jan 1972).

The intensity of a large-amplitude, unstable plasma mode was reduced by applying a pump signal to parametrically couple it to another damped, natural mode of the plasma column. A suppression of the mode is observed when the frequency of the pump ω_0 is equal to the difference between the damped-mode frequency ω_a and the unstable-mode frequency ω_b ($\omega_0 = \omega_a - \omega_b$). The observed behavior of the mode energies is compared with a weak parametric-mode-coupling theory for lumped circuits, which includes nonlinear saturation terms for the unstable mode. (auth)

16695 FEEDBACK STABILIZATION OF A MAGNETICALLY CONFINED PLASMA. Damm, Charles C.; Post, Richard F. (to United States Atomic Energy Commission). U. S. Patent 3,624,240. 30 Nov 1971. Filed 24 Mar 1970.

A high-temperature plasma is produced by the injection and trapping of energetic particles in a magnetic-field containment zone. Detectors are arranged approximate to the plasma to detect electrostatic or electromagnetic signals produced by instabilities in the plasma-containment system. The detected signals are amplified and shifted in phase either positively or negatively with respect to the instability oscillation and are then utilized to modulate an energetic particle beam which is then directed into the plasma containment zone wherein the modulation component of the injected beam interacts with the plasma to minimize or eliminate the instability oscillation of the plasma. Stable containment of the plasma is thereby promoted. (auth)

16696 FEEDBACK CONTROL OF A SELF-EXCITED ELECTROSTATIC WAVE IN A POSITIVE COLUMN. Mase, Atsushi; Tsukishima, Takashige (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 32: No. 2, 522-6(Feb 1972).

Experimental results on a feedback control of a self-excited electrostatic wave in a plasma are compared with a theory where an internal feedback is linked with the external feedback to give a unified account for the feedback control mechanism. The frequency and the damping rate of the self-excited wave undergo some changes upon application of the external feedback. A good quantitative agreement between theory and experiment is obtained. (auth)

16697 SUFFICIENT CRITERIA FOR MAGNETOHYDRODYNAMIC STABILITY. Lortz, D.; Rebhan, E.; Spies, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 11: No. 6, 583-90(Dec 1971).

A class of sufficient stability criteria is derived among which the sufficient criteria known as yet are contained as special cases. In this class, there is an optimum criterion. For equilibria periodic along the magnetic field lines (i.e., having some symmetry or closed field lines) its application requires calculating the lowest eigenvalue of a Sturm–Liouville problem. Various more convenient criteria are obtained from lower bounds of this eigenvalue. These appear well suited for a calculation of lower bounds of a critical β. Some consequences for symmetric equilibria are discussed. (auth)

16698 STABILITY OF THE PLASMA BOUNDARY IN A TRANSVERSE CONSTANT MAGNETIC FIELD AND A HIGH-FREQUENCY CIRCULARLY POLARIZED FIELD. Lozovskii, S. N.; Utkina, L. A. (Physical-Technical Inst., Sukhumi, USSR). Nucl. Fusion; 11: No. 6, 665-7(Dec 1971).

A semi-infinite plasma in a uniform magnetic field, whose lines of force are perpendicular to the plasma surface, is investigated theoretically. Also, the plasma is subjected to a circularly polarized electromagnetic field. The stability of the plasma boundary is investigated in terms of magnetohydrodynamics. (M.O.W.)

16699 ACOUSTIC INSTABILITY OF A NONISOTHERMAL PLASMA IN A MAGNETIC FIELD. Nedospasov, A. V.; Pashkin, S. V. (Inst. of High Temperatures. Moscow. Inst. of Atomic Energy, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 3, 421-4(May-Jun 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 3, 457-61(May-Jun 1971).

The instability of acoustic oscillations in a two-temperature plasma in crossed electric and magnetic fields is considered. It is shown that the instability growth rate and the structure of the developing inhomogeneities depend essentially on the ratio between the electron temperature and the temperature of the heavy component of the plasma. (auth)

16700 NONLINEAR VARIATION OF THE PHASE VELOCITY AND STABILIZATION OF PLASMA OSCILLATIONS. Akhiezer, I. A.; Angeleiko, V. V. (Kharkov State Univ.). JETP Lett. (USSR) (Engl. Transl.); 14: No. 7, 295-7(5 Oct 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 7, 434-6(5 Oct 1971).

Mechanisms for establishing stationary turbulence in plasma are discussed. Ion acoustic oscillations are considered in a strongly magnetized collisionless plasma with hot electrons, through which a cold beam of low density passes along the magnetic field. The nonlinear correction to the electric susceptibility of the plasma, due to random waves, is calculated. (M.O.W.)

16701 DRIFT MOTION AND INSTABILITY OF A PLASMA INJECTED INTO A CURVED MAGNETIC FIELD. Tanaka, Yuji; Oya, Keiji; Okuda, Takayoshi; Yamamoto, Kenzo (Nagoya Univ.). J. Phys. Soc. Jap.; 32: No. 2, 510-16(Feb 1972).

With the aim of realization of an injected type of Tokamak device, the drift motion and instabilities of a plasma in a curved magnetic field are studied experimentally. For this purpose, a curved magnetic field with a straight section is constructed. The plasma is produced by a coaxial gun installed at the end of the straight section. It is found that the transmission of the

plasma is closely related to compensation of the polarization field through the straight section and to the occurrence of an instability. (auth)

16702 THERMAL INSTABILITY WITH VELOCITY SHEAR. Talwar, S. P. (Langley Research Center, Hampton, Va.); Singla, Meera. Astrophys. J.; 172: No. 1, 155-63(15 Feb 1972).

The instability arising due to a tangential discontinuity in velocities in a dilute plasma subject to heating and cooling mechanisms was investigated by using the normal-mode technique. The modifications introduced in the criteria of thermal instability in a static fluid due to the velocity shear are discussed, taking the ambient magnetic field aligned or transverse to flow in each half-space. It is suggested that this instability may play an important role in producing condensations in cosmic fluids. (auth)

16703 ELECTROSTATIC INSTABILITIES OF A MIRROR-CONFINED PLASMA WITH ANISOTROPIC VELOCITY DISTRIBUTION. Hasegawa, Akira; Nishihara, Katsunobu (Bell Telephone Labs., Murray Hill, N. J.). Appl. Phys. Lett.; 20: No. 1, 8-9(1 Jan 1972).

Electrostatic instabilities associated with the bounce frequency are studied for a mirror-confined plasma. A plasma with a monochromatic energy distribution perpendicular to the magnetic field is shown to introduce a new mode at $\omega \sim n\omega_b$ which is unstable when $\omega_p/\omega_b \gtrsim 0(1)$, where ω_b and ω_p are the bounce and plasma frequencies, respectively. (auth)

16704 VELOCITY-SPACE INSTABILITIES IN A HOT ELECTRON PLASMA. Schwartz, M. J.; Lichtenberg, A. J. (Univ. of California, Berkeley). Phys. Fluids; 15: No. 3, 470-8(Mar 1972).

An instability driven by anisotropy in velocity space was studied in a hot electron plasma created by adiabatic compression in a pulsed magnetic mirror. Early in the compression history of the plasma, bursts of radiation occur, with frequencies below the electron cyclotron frequency and its harmonics, with no apparent loss of plasma. The anisotropy in velocity space of the plasma was determined by comparing the measured axial plasma distribution with theoretical profiles. The observed values of plasma density (cold plus hot), temperature and anisotropy are used to find the unstable modes of the complete electromagnetic dispersion relation for all angles of propagation. The fastest growing mode early in the compression cycle is electrostatic occurring below the second harmonic; here, ω_p/Ω (cold) = 1.5, ω_p/Ω (hot) = 0.35. Later in time, ω_p/Ω (cold) = 0.5, ω_p/Ω (hot) = 0.25, and the fastest growing mode is electromagnetic, occurring below the fundamental. These predictions are in agreement with the observed spectrum and polarization measurements. (auth)

16705 PARALLEL VISCOUS MODIFICATION OF THE RESISTIVE TEARING INSTABILITY IN A CARTESIAN MODEL OF THE HARD-CORE PINCH. Marinoff, G. M. (Flinders Univ. of South Australia, Bedford Park). Aust. J. Phys.; 24: No. 6, 929-32(Dec 1971).

The influence of parallel viscosity on the resistive tearing instability in the hard-core pinch is examined. Variation of growth rates with temperature for both viscous and inviscid theory are tabulated. (Australia)

16706 NONLINEAR EFFECTS IN AN RF PLASMA. Boswell, R. W.; Christiansen, P. J.; Salter, C. R. (Univ. of Sussex, Brighton, Eng.). Phys. Lett.; 38A: No. 2, 67-8(17 Jan 1972).

Results are presented which show that a low-frequency plasma instability behaves like a Van der Pol oscillator driven by the modulation frequency of the amplitude modulated rf which produces the plasma. (auth)

Thermonuclear Processes

16707 (IAE-2055) MOVEMENT OF IONS IN A DOUBLE-LENS ACCELERATOR WITH "CLOSED" ELECTRON DRIFT. Zubkov, I. P.; Kislov, A. Ya.; Lebedev, S. V.; Morozov, A. I. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

Ion trajectories in a double-lens accelerator with closed electron drift are calculated, and the results of measurements of the density distributions of the ion current in the accelerator channel are given. The electron temperature and the ionization region of the operating material (hydrogen) are determined. (JPRS)

16708 (TID-25823) PROBLEMS IN COUPLING A GAS TURBINE TO A THERMONUCLEAR REACTOR. Fraas, A. P. (Oak Ridge National Lab., Tenn.). Mar 1972. 27p. Dep. NTIS.

The problems associated with cooling a reactor blanket with helium and employing the heat removed to drive a gas turbine cycle are discussed. A comparison is made of helium and potassium blanket cooling systems. (M.O.W.)

16709 PULSED LASER-IGNITED THERMONUCLEAR REACTOR. Fraas, Arthur P. (to United States Atomic Energy Commission). U. S. Patent 3,624,239. 30 Nov 1971. Filed 11 Feb 1970.

Ignition takes place within a void in liquid lithium contained within a pressure vessel. The void in the liquid lithium is created by injecting the lithium tangentially into the pressure vessel, by spraying the lithium through jets, or a combination thereof. Introducing bubbles in the liquid decreases the shock wave forces at the pressure vessel wall. The lithium, which is heated by the thermonuclear reactions created within the void, is passed through a heat exchanger and tritium recovery system for heating a working fluid for the power-producing system and for recovery of the tritium produced in the lithium by the reactions. (auth)

16710 THERMAL EFFICIENCY OF MIRROR REACTORS WITH DIRECT CONVERSION. Galbraith, D. L.; Kammash, T. (Univ. of Michigan, Ann Arbor). Nucl. Fusion; 11: No. 6, 575-82(Dec 1971).,

One measure of the viability of any power-producing system is the thermal efficiency—a quantity that reflects the extent to which waste heat is rejected into the surroundings. Using an efficiency of 50% as basis for comparison the thermal efficiency of a mirror fusion reactor with direct conversion for two fuel cycles was calculated. It is shown that a D-T mirror reactor may be marginally competitive if current estimates of direct conversion and injection efficiencies prove realistic. The D-^{3}He mirror reactor appears less hopeful unless these efficiencies can be significantly improved or the required injection power greatly reduced. (auth)

16711 COMPARISON BETWEEN STATIONARY TOKAMAK MODELS. Nuehrenberg, J. (Courant Inst. of Mathematical Sciences, New York). Nucl. Fusion; 11: No. 6, 655-60(Dec 1971).

Two distinct, essentially self-contained models for a stationary tokamak are discussed. They are the classical-diffusion and thermal-equilibrium models. The effects of various modifications of the models are described. (M.O.W.)

16712 CONTROLLED NUCLEAR FUSION. Pease, R. S. (Culham Lab., Abingdon, Eng.). Energ. Atomtech.; 24: No. 2, 94-9(Feb 1971). (In Hungarian).

A summary is given of the present state of research on nuclear fusion. (auth)

16713 NUCLEAR REACTIONS IN FULLY IONIZED PLASMAS AT HIGH TEMPERATURES. Lehner, G. (Institut fuer Plasmaphysik, Garching, Ger.). pp 509-73 of Reactions Under Plasma Conditions. Vol. II. /Venugopalan, M. (ed.). New York; John Wiley and Sons, Inc. (1971).

Nuclear reactions are theoretically discussed for dense, high-temperature laboratory and stellar plasmas. Neutron calculations are made. Some experiments involving nuclear reactions are described. (M.O.W.)

16714 THERMONUCLEAR REACTION WAVES AT HIGH DENSITIES. Chu, M. S. (Columbia Univ., New York). Phys. Fluids; 15: No. 3, 413-22(Mar 1972).

The initiation, development, and propagation of thermonuclear reaction waves in a solid-density deuterium-tritium plasma are presented. Physical effects due to thermonuclear reactions, heat conduction, electron-ion equilibration, bremsstrahlung, and fluid dynamics are contained in the analysis. The qualitative behavior of the physical variables is discussed, and solutions of the equations are obtained by employing finite-difference numerical techniques. Due to plasma properties and the form of the fusion reaction cross section, important differences exist between fusion and chemical detonation waves. Threshold ignition energy is found for simple geometries and the complete history of the development of the wave is studied. The structure of a fully developed fusion reaction wave is presented. Finally, the thermonuclear energy yield from small D-T pellets is presented. (auth)

16715 PROBLEM OF THERMONUCLEAR BURNING IN BOUNDED PLASMA. Nastoyashchii, A. F. At. Energ. (USSR); 32: No. 1, 43-8(Jan 1972). (In Russian).

The existence of quasi-steady states of thermonuclear plasma confined within material walls with infinite heat capacity is considered. The plasma density is assumed to be close to the density of a solid matter. It is shown that a thermal equilibrium of such a plasma is feasible only when the product of the plasma density and its characteristic dimension exceeds some definite value: $(n_0 d) > (n_0 d)_{cr}$. At $(n_0 d) < (n_0 d)_{cr}$, the rapid plasma cooling and damping of the thermonuclear reaction occurs. A solution is

given for three simple cases: plane sheet, infinitely long cylinder, and sphere. It is found that two types of the stationary solutions take place: at the low and high plasma temperatures. The plasma equilibrium at the low temperature proved to be unstable: a slight overheating of the plasma leads to a "self heating." The energy needed for ignition of a self-maintained fusion reaction is discussed. It is shown that "the ignition energy" required decreases with increase of the thermonuclear material density and with growth of magnetic field, which reduces the plasma heat losses caused by the thermal conductivity. (auth)

16716 ELEKTRODINAMICHESKOE USKORENIE PLAZMY. (Electrodynamic Acceleration of Plasmas). Kolesnikov, P. M. Moscow; Atomizdat (1971). 392p.

The electrodynamics of moving media are examined with the aid of Maxwell equations in integral and differential form, and with models of electrical circuits in quasi-stationary electromagnetic fields. The motion of charged particles in electromagnetic fields of various kinds is reviewed. Rarefied plasmas, kinetic methods and hydrodynamics, and pulsed acceleration of plasmas are discussed. Stationary acceleration and nonstationary magnetohydrodynamic acceleration of plasmas are contrasted, and a final chapter deals with Hall acceleration by means of Hall currents in strong magnetic fields. (289 references) (K.S.W.)

16717 CURRENT SHEET STRUCTURE IN AN INDUCTIVE-IMPULSIVE PLASMA ACCELERATOR. Dailey, C. L. (TRW Systems Group, Redondo Beach, Calif.); Lovberg, R. H. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 2, 125-9(Feb 1972).

Probe and laser light-scattering measurements of electron density were made in the current sheet of a pulsed inductive accelerator. The discharge consists of a thin flat disk of pure j_θ current. The only current carriers are electrons. The gas is ionized and swept up into a 4-mm-thick current sheet. Ions are accelerated by an axial E field, ahead of the mass layer, produced both by electron current and negative electron pressure gradient. This field nearly vanishes at the rear of the mass layer where the $J \times B$ force balances the positive electron pressure gradient. (auth)

16718 HIGH-SPEED NUMERICAL CONTROL OF A LASER BEAM FOR A LASER PLASMA INJECTOR. Ward, B. A. (Culham Lab., Abingdon, Eng.). Appl. Opt.; 11: No. 2, 331-8 (Feb 1972).

A system that enables a closed-line magnetic confinement device to be filled with a laser-produced hydrogen plasma was constructed. The design and initial performance of this system using targets 0.25 mm in diameter is reported. The device moves the laser focus to intercept an injected pellet within a specified target area. The system detects the path of the pellet after launching, electronically predicts its trajectory, and deflects mirrors to a position that will move the laser focus to intercept the pellet within the target area. Glass pellets were used to commission the system, and all that passed through the detector area were successfully intercepted. (auth)

16719 PRELIMINARY MEASUREMENTS OF X-RAY AND NEUTRON EMISSION FROM LASER-PRODUCED PLASMAS. Mead, S. W.; Kidder, R. E.; Swain, J. E.; Ranier, F.; Petruzzi, J. (Univ. of California, Livermore). Appl. Opt.; 11: No. 2, 345-52(Feb 1972).

Two Nd-glass laser systems were assembled for producing high-temperature plasmas. The smaller laser, which gives subnanosecond pulses of about 5 J, was used primarily for x-ray studies. The spectrum above 2 keV is being explored, using Bragg reflection from a cylindrically curved graphite crystal. Line radiation appears to be present in the spectra measured for laser-produced plasmas of lead and gold. Plasma temperatures implied by x-ray transmission measurements are found to vary with absorber thickness. Temperatures of a few tens of keV, inferred from thick-absorber measurements of low-Z plasmas, suggest the operation of anomalous heating mechanisms. A second glass laser system, involving face-pumped disks 14 cm in diameter, is also in use for plasma-heating experiments and has led to the production of D–D neutrons. This system was used to produce pulses of several tens of joules in a few nanoseconds for recent experiments. A calibrated plastic scintillator with two photomultipliers is used for neutron detection. Targets of CD_2 have produced total yields of more than 10^4 neutrons. Effective neutron production appears to require laser pulses longer than 2 nsec and to be accompanied by a large reflected pulse. (auth)

16720 SIMPLE UNIPOLAR PULSED PLASMA ACCELERATOR. Jurak, K.; Offenberger, A. A. (Univ. of Alberta, Edmonton). Rev. Sci. Instrum.; 43: No. 1, 48-50(Jan 1972).

The design and operation of a current-pulse-forming network using two trigatrons for unipolar pulse generation in plasma accelerators are described. Only the first trigatron has external triggering. The resulting current pulse is approximately 100 kA of 35-μsec duration and has a shorter rise than fall time. Calculated characteristics show good agreement with measured values. (auth)

16721 PERFORMANCE OF QUASI-STEADY MPD THRUSTERS AT HIGH POWERS. Malliaris, A. C.; John, R. R.; Garrison, R. L.; Libby, D. R. (Avco Corp., Wilmington, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 2, 121-2 (Feb 1972).

The familiar axisymmetric MPD thruster considered has a conical tungsten tip cathode ($\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{4}$ in. diam) and a copper plate anode-orifice (2, 3, and 4 in. diam). The performance of such thrusters is investigated, with millisecond pulses, over a wide range of experimental conditions. The five noble gases are used as propellants, at flow rates in the range 0.1 to 100 g-sec^{-1}; MPD currents 5 to 50 kA are employed and the corresponding input powers are in the range 0.1 to 10 MW. Thrust is determined from impulse measurements with well-known current waveforms, while instantaneous measurements are made for all other variables: $\dot{m}$, J, and V, flow rate, current, and voltage. A detailed analysis of the experimental results shows that the MPD performance is limited by a critical value of $(J^2/\dot{m})$, which depends only on MPD geometry and on propellant properties. MPD operation, beyond the critical point, becomes increasingly objectionable on account of instabilities, sharp rise of the voltage, erosion, and participation of spurious propellant. At the limit of credible MPD operation, the specific impulse depends on propellant properties only, and varies from about 3000 sec for lighter propellants to about 400 sec for heavier propellants. In the same range, the maximum credible MPD efficiency varies from about 30% to about 10%. However, the efficiency depends on other MPD conditions also. (auth)

16722 FULLY IONIZED QUASI-ONE-DIMENSIONAL MAGNETIC NOZZLE FLOW. Chubb, Donald L. (Lewis Research Center, Cleveland). AIAA (Amer. Inst. Aeronaut. Astronaut) J.; 10: No. 2, 113-14(Feb 1972).

To investigate magnetic nozzle processes, a quasi-one-dimensional analysis was employed that included the effects of unequal electron and ion temperatures and electron thermal conductivity. (auth)

16723 ELECTRIC FIELD IN A SLOTTED TOROIDAL CHAMBER. Stotland, M. A.; Khil, Sh. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 8, 1233-7(Feb 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 8, 1563-70(Aug 1971).

The quasi-stationary approximation is used to study the electric field in a toroidal metal chamber provided with meridional and equatorial slots for entry of an introduction field. The electric field outside a single-turn toroidal coil with meridional slots is analyzed. (auth)

16724 MAGNETIC FIELD AND HIGH-FREQUENCY INDUCTANCE OF NESTED TOROIDS. Stotland, M. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 8, 1238-43(Feb 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 8, 1571-8(Aug 1971).

Expressions are obtained for the vector potential, current density, and high-frequency inductance of nested toroids that coincide with the coordinate surfaces of a toroidal system of coordinates. The expressions are derived on the assumption of a strong skin effect, i.e., negligible skin depth. The effect of a slot in the meridian plane in the outer toroid is investigated. The surface current distributions that arise when a high-frequency voltage is applied to the slot are determined. (auth)

Wave Phenomena

Refer also to abstracts 16690 and 16696.

16725 (AD–731392) NONLINEAR EXCITATION OF WAVES IN A PLASMA BY HIGH-POWER MICROWAVES. Shiue, James C. (New York Univ., N. Y. Dept. of Electrical Engineering). Feb 1971. Contracts N00014-67-A-0467-0018; Nonr-285(66). 255p. NTIS.

Nonlinear excitation of electron plasma and ion acoustic waves in an isotropic electron–ion plasma was investigated theoretically and experimentally. A parametric theory based on a fluid description of the plasma, taking into account the vector characters of the pumping and driven waves is developed that displays the directional characteristic of the threshold. A transmission-line equivalent circuit is used to represent a plasma slab from which the ratio of the E fields of an E-polarized incident electromag-

netic wave to the electron plasma wave inside the plasma at a Tonks–Dattner resonance is ascertained. Experiments are conducted on argon and mercury plasmas in C-band waveguides with cw and pulsed microwaves. The minimum threshold microwave power observed is 10 W. Pulsed experiments show details of suppression of spontaneous oscillations in the plasma and subsequent excitation of ion acoustic waves. The dependence of the threshold microwave power on background plasma parameters is in qualitative agreement with theory. (auth) (USGRDR)

16726 (IYAF–64–70) THERMAL SHOCK WAVE IN PLASMA. Zolotovskii, O. A.; Koroteev, V. I.; Kurtmullaev, R. Kh.; Semenov, V. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1970. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

The disturbances that arise during the propagation of a cloud of "hot" electrons through cold plasma along a magnetic field are examined. Under fixed conditions, a transfer of heat that has been stored in the electron component of the plasma, occurs at a rate much less than the thermal velocity of "hot" electrons; a temperature jump results. The formation of this unique thermal shock wave is associated with the incipient friction of a countercurrent of cold electrons upon ions, the source of which may be ion-acoustic instability. The measured velocity and the front width of the disturbance agrees with theory. Parameters are formulated for a velocity of the disturbance approximating the thermal velocity of "hot" electrons. It is difficult here to clearly identify a quasistationary front of disturbance and their character. (tr-auth)

16727 (IYAF–66–70) INVESTIGATION OF SHOCK ION WAVE IN COLLISIONLESS PLASMA. Alikhanov, S. G.; Belan, V. G.; Kichigan, G. N.; Chebotaev, P. Z. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1970. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The structure of a collision-free shock wave in a plasma was studied with hot ions in the absence of a magnetic field. The results of a theoretical analysis were compared with experimental results with respect to propagation of an ion wave of finite amplitude in a laboratory plasma, and with the results of a numerical experiment on a "machine plasma". (tr-auth)

16728 (IYAF–80–70) FINE STRUCTURE OF SHOCK WAVES IN PLASMA AND SATURATION MECHANISM OF ION-ACOUSTIC TURBULENCE. Eselevich, V. G.; Eskov, A. G.; Kurtmullaev, R. Kh.; Malyutin, A. I. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1970. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

The fine structure of a shock wave front was investigated for $M < 2.5$. Magnetic-field and electric-potential measurements were conducted with probes of special construction having a resolving capability of 0.1 mm. Detailed study of the field distribution showed that super resistance was developed only after preliminary "warmup" of the electrons, either because of pair collisions or beam instability. The effective collision frequency in the turbulent region of the front is not at variance with the hypothesis of a linear interaction of phonons with ions. (tr-auth)

16729 (KHFTI–70–75) THEORY OF WAVE INTERACTIONS IN BEAM–PLASMA SYSTEMS IN MAGNETIC FIELDS. Korsunskii, A. M.; Repalov, N. S.; Khizhnyak, N. A. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1970. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A plasma–electron beam may be used in apparatus designed for forming intense waves with three-dimensional charge, which in turn may be used for accelerating ions. Ion acceleration imposes rigid requirements on the form of the accelerating field. Accordingly, problems associated with the stability of the spectrum of these fields are extremely important. The nonlinear region of plasma oscillations was studied, with an electron beam situated in a homogeneous magnetic field. Stable and unstable areas of operation were found, and the dynamics of energy exchange between isolated waves were investigated. (tr-auth)

16730 (NP–19164) SELF-ACTION OF ELECTROMAGNETIC WAVES IN DENSE COLLISIONLESS PLASMA. Batanov, G. M.; Silin, V. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Various mechanisms of interaction of ultrahigh frequencies in a collision-free plasma were investigated. The penetration of a high-power electromagnetic wave for a distance of 10 cm in a dense plasma was experimentally measured. The maximum concentration of electrons in a layer of collision-free plasma exceeds the critical by a factor of five. The penetration of an ultrahigh-frequency wave into plasma layers was observed to follow the relationship $E_0^2/8\pi \ll nT_e$. Using a Langmuir probe and microwave diagnostic measurements, ion-acoustic oscillations were observed in regions neighboring plasma resonance. The observed effects were interpreted in the light of a parametric instability of the plasma in an ultrahigh-frequency field. (tr-auth)

16731 (ORNL–TM–3671) COUPLING OF TRANSVERSE WAVES TO ELECTROSTATIC MODES IN A MAGNETIZED PLASMA. Callen, J. D.; Guest, G. E. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 57p. Dep. NTIS.

The complete dispersion relation governing longitudinal and transverse waves in an infinite, homogeneous, magnetized plasma is discussed for arbitrary directions of wave propagation. Various forms suitable for computing modifications of the electrostatic dispersion relation arising from the coupling to transverse waves when $\omega_{pe} \gtrsim ck$, are compared. The modifications that arise for electrostatic-ion gyroharmonic instabilities are determined in an ordering scheme appropriate for the important unstable modes of a mirror-confined thermonuclear plasma. The resultant effects on a number of electrostatic modes are discussed. (auth)

16732 REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES BY A SEMI-INFINITE MOVING ANISOTROPIC PLASMA. Ohkubo, M. (Gunma Univ., Kiryu, Japan). Radio Sci.; 6: No. 10, 925–30(Oct 1971).

The reflection and transmission of electromagnetic waves by a semi-infinite moving plasma with a static magnetic field parallel to the moving direction are investigated for the incident H-plane wave. Numerical results for the reflection coefficient as functions of incident angle, velocity, frequency, and cyclotron frequency are given. It is shown that the moving anisotropic plasma exhibits several phenomena different from manifestations of the stationary case. (auth)

16733 ACOUSTIC-WAVE GENERATION IN A LOW-PRESSURE AFTERGLOW. Ventrice, Carl A. (Tennessee Technological Univ., Cookeville). Phys. Rev. Lett.; 28: No. 3, 142–4 (17 Jan 1972).

The afterglow of a weakly ionized helium plasma was investigated using an electrostatic probe. The existence of acoustic waves generated at the onset, or very early afterglow, was confirmed at neutral gas pressures as low as 0.1 torr. (auth)

16734 PROPAGATION OF ION FREE-STREAMING WAVES. Yamauchi, Mineo (Tokyo Univ. of Education). J. Phys. Soc. Jap.; 32: No. 2, 527–34(Feb 1972).

Propagation of two ion waves—a fast and a slow one—was observed in an ion-drifting plasma. When the exciting frequency was above the ion plasma frequency, the slow wave disappeared but the fast one did not. The two waves were identified as the ion acoustic waves riding on the ion drifting plasma in the frequency range much below the ion plasma frequency. The fast wave, at frequencies above the ion plasma frequency, was essentially the ion free-streaming wave. A dispersion relation of an ion free-streaming wave was derived on the assumption that the drifted Maxwellian distribution was the initial distribution. The computed phase velocity and damping rate were in agreement with the experimental results. (auth)

16735 NONLINEAR BEHAVIORS OF ION WAVES. Kako, Masashi; Watanabe, Tsuguhiro (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 32: No. 2, 535–42(Feb 1972).

The following equation is shown to govern the finite-amplitude ion wave propagating through a macroscopic plasma with an ion beam in the neighborhood of a marginally stable state: $(\partial^2\psi/\partial\tau^2) + \alpha(\partial^2\psi/\partial\xi^2) + (\partial^4\psi/\partial\xi^4) + (\partial^2\psi^2/\partial\xi^2) = 0$, where α denotes the deviation of the plasma system from the marginal state. It is found that wave trains or solitary waves exist. The temporal evolution of initial disturbances is investigated numerically. (auth)

16736 BALLISTIC CONTRIBUTIONS TO ION ACOUSTIC WAVES IN A PLASMA. Sato, Noriyoshi; Sasaki, Akihiko (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 32: No. 2, 543–51 (Feb 1972).

Propagation and damping of low-frequency perturbations produced by a grid are measured in an almost isothermal plasma. The phase velocity and the damping factor are observed to depend on the position over about half a wavelength from an exciting position. Beyond that, Landau-damped ion acoustic waves propagate. The phenomena observed can be interpreted as ion ballistic contributions to ion acoustic waves. (auth)

16737 PERTURBATION THEORY OF THE NONLINEAR PLASMA WAVE WITH LANDAU DAMPING. Sanuki, Heiji; Todoroki, Jiro (Nihon Univ., Tokyo). J. Phys. Soc. Jap.; 32: No. 2, 517–21(Feb 1972).

A generalized Korteweg–de Vries type of equation is obtained for small- but finite-amplitude waves in plasma by treating the Vlasov equation perturbation theoretically. The influence of ion Landau damping on the ion sound soliton is discussed. Even if the ion acoustic wave is stable, it is shown that, under a certain condition, the amplitude of the soliton grows in time. In the case of the unstable ion acoustic wave, the amplitude of the soliton saturates at the finite value. (auth)

16738 INITIAL-VALUE PROBLEM FOR PLASMA OSCILLATIONS IN A UNIFORM MAGNETIC FIELD. Mason, David Paul (Univ. of the Witwatersrand, Johannesburg). Ann. Phys. (N. Y.); 69: No. 1, 56-75(Jan 1972).

The solution is given of the initial-value problem for the nonrelativistic linearized Vlasov–Maxwell equations describing longitudinal and transverse plasma oscillations in an external uniform magnetic field. The problem is solved for all directions of propagation except normal to the external magnetic field, and the equilibrium distribution is not assumed isotropic. The method of solution is an extension of Van Kampen's eigenfunction expansion technique, already developed considerably by Zelazny and McCune, in which the problem is reduced to the solution of a system of singular integral equations. (auth)

16739 SPATIAL EVOLUTION OF LOW-FREQUENCY PERTURBATIONS PRODUCED BY A GRID IN A PLASMA. Sato, N.; Sasaki, A. (Tohoku Univ., Sendai). Phys. Fluids; 15: No. 3, 508-10(Mar 1972).

The phase velocity and damping factor of grid-excited perturbations are observed to depend on the position over about half a wavelength from an exciting source. Beyond there, Landau-damped ion acoustic waves propagate, as predicted theoretically. (auth)

16740 STABILITY OF A STEADY, LARGE-AMPLITUDE WHISTLER WAVE. Palmadesso, P. J. (Goddard Space Flight Center, Greenbelt, Md.); Schmidt, G. Phys. Fluids; 15: No. 3, 485-92(Mar 1972).

The behavior of weak electrostatic waves in a collisionless magnetoplasma supporting a steady large amplitude whistler wave was studied. All waves are assumed to propagate parallel to a uniform background magnetic field B_0. In the presence of the whistler wave fields each particle executes an oscillatory motion parallel to B_0, in addition to a translation along B_0 and transverse motions. This oscillation causes the Landau resonance to be replaced by a series of new resonances between particles and the electrostatic modes. A distribution function for the perturbed plasma is constructed by solving the Vlasov equation, linearized in the electrostatic wave amplitudes. A dispersion relation is obtained and solved approximately for the growth/damping rate of the perturbations. Growing electrostatic modes are found to be approximately uncoupled. Trapped particles have a strong influence on the stability of the system. (auth)

16741 COUPLED-MODE PROPAGATION IN AN INHOMOGENEOUS PLASMA IN THE PRESENCE OF SHEAR. Cano, R.; Schwartz, M. J.; Zanfagna, B. (CEN-CEA, Fontenay-aux-Roses, France). Phys. Fluids; 15: No. 3, 479-84(Mar 1972).

An experiment is discussed in which an electromagnetic wave polarized in the extraordinary mode is propagated through a plasma confined by a magnetic field having a weak shear, which results in creation of an ordinary wave component. Resonant and nonresonant conditions of propagation are explored for the incident extraordinary wave. The transmitted power in the extraordinary and ordinary modes is measured as a function of magnetic field for constant plasma density. Theoretical results obtained numerically from the coupled second-order equations describing propagation in a weakly inhomogeneous plasma with shear are found to be in substantial agreement with the experimental results. Relevance of this work to the spatial determination of the poloidal magnetic field in tokamaks is suggested. (auth)

16742 SOME EXPERIMENTAL RESULTS ON ACOUSTIC WAVE PROPAGATION IN A PLASMA. Fitaire, M.; Mantei, T. D. (Univ. de Paris-Sud, Orsay, France). Phys. Fluids; 15: No. 3, 464-9(Mar 1972).

Three aspects of the theory of propagation of sound in a plasma are experimentally confirmed. It is shown that: (1) the source term for the generation of sound in the neutral gas is proportional to the time derivative of the power input to the electrons from an externally applied electric field, (2) at low frequencies the electronic and neutral fluid components move together approximately in phase when an acoustic wave propagates through the plasma, and (3) the resonance curve of an acoustic cavity is sharpened by the presence of plasma; this effect is attributed to the collisional transfer of energy from the electrons to the neutrals. (auth)

16743 NONLINEAR THEORY OF FREQUENCY SHIFTS AND BROADENING OF PLASMA WAVES. Weinstock, Jerome (National Oceanic and Atmospheric Administration, Boulder, Colo.). Phys. Fluids; 15: No. 3, 454-9(Mar 1972).

It is shown that the linear dispersion relation for plasma waves is converted into a nonlinear one by making the replacement $\omega \to \omega + \delta\omega + i d_w$. Here, ω is the wave frequency, and $\delta\omega$ and d_w are real nonlinear wave quantities that are explicitly calculated. The wave damping decrement d_w has been determined in previous investigations, and shown to increase wave damping. Here, the nonlinear frequency shift $\delta\omega$ is determined for a wide class of conditions. It is shown to have a direct and calculable influence on the frequencies of general electrostatic waves in magnetoplasmas. It is further shown that $\delta\omega$ implies a splitting and broadening of frequency spectra of low-frequency waves. The calculated value of such broadening is in good agreement with observations by Sheffield, and Halseth and Pyle. The present method is based on the use of an averaging operator to express the nonlinear dispersion relation in terms of perturbed orbit function. Cumulant expansions are then used to express the orbit function in terms of $\delta\omega$, and to evaluate $\delta\omega$ in terms of the plasma parameters in the same fashion as has been done for d_w. (auth)

16744 CHARGE-SEPARATION EFFECTS ON THE PROFILE OF A PERPENDICULAR SHOCK WAVE. Hu, Pung Nien (Aeronautical Research Associates of Princeton, Inc., N. J.); Grad, Harold. Phys. Fluids; 15: No. 3, 402-12(Mar 1972).

The profile of a plasma shock wave propagating perpendicular to a magnetic field is studied, using a system of moment equations derived from a pair of Boltzmann equations for electrons and ions. The system, rigorously closed for weak shocks, describes a fully ionized plasma in which a long list of dissipative mechanisms and Hall effects are coupled. The charge separation effect which is automatically excluded by the usual weak shock scaling [P. N. Hu, Phys. Fluids, 9: 89(1966) and H. Grad and P. N. Hu, Phys. Fluids, 10: 2596(1967)] is retained in this description by a special nonuniform scaling of the Debye length relative to the shock strength. The shock profiles are obtained from an equation with two essential parameters (combining five dimensionless parameters which occur in the problem). The magnetic field profiles cover the entire range from collision-dominated monotonic profiles to damped oscillatory profiles and the limiting collisionless case of purely oscillatory and solitary wave profiles. The profiles of the electric field and the charge density can also be oscillatory or monotonic, and, in some parameter ranges, have long downstream tails extending far beyond where the velocity and the magnetic field are undisturbed. (auth)

16745 NONLINEAR MOTIONS IN AN ANISOTROPIC PLASMA. Berezin, Yu. A. (Computer Center, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1877-81(Nov 1971). (In Russian).

Nonlinear Alfven waves propagating along a magnetic field in an anisotropic plasma are studied under hose-instability conditions. (auth)

16746 NONLINEAR INTERACTION OF ELECTROMAGNETIC WAVES IN A MAGNETIZED ELECTRON BEAM. Bajwa, G. S.; Srivastava, K. M. (Univ. of Jodhpur, India). Indian J. Phys.; 44: No. 7, 386-91(Jul 1970).

The nonlinear interaction of electromagnetic waves in a magnetized electron beam is investigated. The waves are taken to be propagating across a uniform magnetic field. It is established that extraordinary waves are generated when two ordinary and two extraordinary waves interact. (auth)

16747 MICROWAVE MODULATION IN A TIME-DEPENDENT PLASMA. PART I. PLASMA SUBJECTED TO A TIME-DEPENDENT MAGNETIC FIELD. Kumar, Satyendra; John, P. I.; Sarkar, D. C. (Aligarh Muslim Univ., India). Indian J. Pure Appl. Phys.; 9: No. 8, 673-6(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

A theory of the modulation of microwaves propagated through a plasma subjected to a low-intensity, longitudinal, time-dependent magnetic field is presented. Numerical calculations show that the modulation is appreciable and measurable. An X-band microwave propagation system suitable for study of propagation of microwaves through magnetoplasmas is described. Experimental difficulties encountered in the study of modulation of microwaves propagated through an rf plasma subjected to a time-dependent magnetic field are also considered. (auth)

16748 EFFECT OF ION MIXTURES ON PROPAGATION OF DRIFT WAVES IN A FULLY IONIZED PLASMA. Aldridge, R. V. (Univ. of East Anglia, Norwich, Eng.). Phys. Lett.; 38A: No. 2, 133-4(17 Jan 1972).

Propagation of drift waves in a fully ionized plasma consisting of a mixture of electrons and two ion species is treated theoretically. (auth)

16749 INTERFERENCE PATTERN OF ION WAVES. Takamura, S.; Okuda, T. (Nagoya Univ., Japan). Phys. Lett.; 38A: No. 2, 138(17 Jan 1972).

The interference patterns of ion waves are observed when the wave damping is almost neglected. (auth)

16750 PROPAGATION OF ELECTRON WAVES IN A HOMOGENEOUS PLASMA IN A BROAD FREQUENCY RANGE. Henry, D.; Treguier, J. P. (CNET, Lannion, France). Phys. Lett.; 38A: No. 2, 115-16(17 Jan 1972).

An experiment is described in which longitudinal waves are detected in a range from 0.6 to 2.0 times the plasma frequency. Dispersion curves are found. One of them fits the classical Landau mode, while the other one is shown to be mainly due to the ballistic term. A discussion concerning the possibilities of detecting the ballistic waves is presented. (auth)

16751 THERMAL SPREAD AND WAVE PROPAGATION NEAR RESONANCES IN A MAGNETOPLASMA. Sestero, A. (EURATOM–CNEN, Frascati, Italy). Lett. Nuovo Cim.; 2: No. 26, 1335-8(25 Dec 1971).

The propagation of electromagnetic waves in a uniform magnetoplasma is considered for frequencies in the neighborhood of the electron cyclotron resonance frequency. A dispersion relation for the transverse modes is given. The fluid-dynamic and kinetic cases are described. (M.O.W.)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

16752 (ANL–7853) ENERGY-DEPENDENT TRANSPORT THEORY WITH A SEPARABLE KERNEL. EBR-II Project. Larson, H. A. (Argonne National Lab., Ill.). Oct 1971. Contract W-31-109-eng-38. 30p. Dep. NTIS.

The energy- and angle-dependent reflection and transmission distributions for the slab-albedo problem are obtained for scattering described by a separable kernel. These solutions follow by relating the solution of the nonlinear, invariant-imbedding integral equations to the end point values of an inhomogeneous, linear Fredholm integral equation. Use of a stochastic description also permits determination of the mean number of collisions suffered by a particle before it emerges from a face of the slab. Numerical results are obtained for neutrons incident upon a free gas. (auth)

16753 (RLO–2221-T-6-11) DERIVATION OF PROBABILITY AMPLITUDES FOR TWO-PHOTON ABSORPTION. Stoner, T. R.; Gruber, J. B.; Olsen, D. N. (Washington State Univ., Pullman. Dept. of Physics). [nd]. Contract AT(45-1)-2221-T-6. 21p. Dep. NTIS.

Using time-dependent perturbation theory, the transition probability for two-photon absorption is developed in detail. Two cases are considered: absorption of a laser photon and an auxiliary light source photon and absorption of two laser photons. Expressions for two-photon absorption coefficients were found and simplified by using the closure procedure that Kleinman (Phys. Rev., 125: 87(1962)) used for evaluating the infinite sum that appears in these expressions. (auth)

16754 CHARACTERISTIC ENERGY-LOSS SPECTRA OF TITANIUM, VANADIUM, AND CHROMIUM. Simmons, Gary W.; Scheibner, E. J. (Georgia Inst. of Tech., Atlanta). J. Appl. Phys.; 43: No. 2, 693-700(Feb 1972).

Electron energy losses in titanium, vanadium, and chromium were measured on evaporated-film specimens in ultrahigh vacuum. Measurements were made with a retarding-field analyzer, and the surface purity was monitored by Auger spectroscopy. The energy-loss spectra for clean surfaces of these metals showed similarities in line shape and in their behavior toward oxygen adsorption. In the energy range 0 to 30 eV, the loss spectra were composed of four peaks that were interpreted as due to a surface-plasma loss, bulk-plasma loss, combination surface–bulk loss, and a second harmonic volume loss. The energy values (in eV) for these four peaks, in the order listed above, were measured as follows: Ti(5.0, 11.5, 17.0, 24.6), V(5.1, 10.5, 16.5, 24.0), and Cr(5.0, 9.5, 15.5, 23.5). Changes in the surface-loss intensity were observed for oxygen coverages on the order of 0.04 monolayer. The measured energies for the bulk–plasma excitation were found not to be in agreement with calculated values according to the classical theory for collective oscillations in solids. The present results are compared with characteristic energy-loss data reported in the literature. (auth)

16755 RADIOACTIVE FRAGMENTATION OF N^{7+} ION BEAM OBSERVED IN A BERYLLIUM TARGET. Tobias, C. A.; Chatterjee, A.; Smith, A. R. (Univ. of California, Berkeley). Phys. Lett.; 37A: No. 2, 119-20(8 Nov 1971).

280 MeV/nucleon nitrogen ion beam was stopped in a beryllium target. Radioactive isotope ^{11}C (half-life 20.34 min) was produced by the fragmentation of the incident ion. This phenomenon is called "auto activation." (auth)

16756 INVESTIGATION OF THE NUCLEAR STOPPING MECHANISM BY HEAVY PARTICLE RANGE MEASUREMENTS IN ISOTOPIC MEDIA. Leon, J.; Steiger-Shafrir, N. H. (Technion-Israel Inst. of Tech., Haifa). Can. J. Phys.; 49: 2106-17 (15 Aug 1971).

An experimental study of the nuclear stopping mechanism was carried out by performing high precision range and range straggling measurements of 96.5-keV ^{224}Ra α-disintegration recoil particles in the following isotopic gases: $H_2/D_2/T_2$, $^3He/^4He$, $^{14}N_2/^{15}N_2$, $^{16}O_2/^{18}O_2$, and $^{20}Ne/^{22}Ne$. Distinct range differences for light to heavy isotope mass ratios up to about 0.9 were determined. The results obtained establish clearly that the prediction of the isotope effect of the stopping medium, as derived from the Lindhard theory by using the power law potential as an approximation to the Thomas–Fermi potential, is, to a good degree of accuracy, confirmed by experiment. (auth) (Canada)

16757 SCATTERING OF LOW ENERGY PROTONS IN MATTER. Arkhipov, E. P.; Gott, Yu. V. At. Energ. (USSR); 31: No. 5, 477-80(Nov 1971). (In Russian).

Some theoretical and experimental results for multiple scattering of low-energy protons are reported. The calculation of the angular distribution is based on a differential scattering cross section for the potential of r^{-s} type. The scattering distributions were measured for protons in Ni, Si, Fe, Bi in the energy range 2 to 30 keV. The agreement between experimental and theoretical values is satisfactory. (auth)

16758 DOSE CHARACTERISTICS OF 200 MeV PROTONS. Zel'chinskii, M. (Inst. of Nuclear Research, Swierk, Poland); Pshona, S.; Komochkov, M. M.; Sychev, B. S.; Cherevatenko, A. P. At. Energ. (USSR); 31: No. 5, 473-6(Nov 1971). (In Russian).

The dose depth and quality factor distributions were measured for a 200-MeV narrow proton beam in conditions of irradiation corresponding to the normal incidence of a broad monoenergetic proton beam on an infinite tissue-equivalent slab 30 cm thick. Value of the quality factor proved to be 1.4 ± 0.3 rem/rad and varied with depth very slightly, increasing in the region of the Bragg peak only. A quality factor 5.5 ± 1.5 rem/rad was observed at the phantom depth 28 cm, beyond the Bragg peak. Absorbed dose at the phantom depth of 5 cm, for unit proton fluence, was equal to 81 ± 8 rad/prot $\cdot$ cm^{-2}. The experimental data diverge from the ICRP recommendations. (auth)

16759 REVERSIBLE CHANGES IN DIELECTRIC CHARACTERISTICS OF SOME POLYMERS FOLLOWING GAMMA IRRADIATION. Matveev, V. K.; Vayasberg, S. Zh.; Karpov, V. L. Plast. Massy; No. 6, 34-7(Jul 1971). (In Russian).

Reversible changes in the dielectric loss induced by γ radiation were investigated for the following polymers: poly(vinyl chloride) (PVC), polytrifluorochloroethylene (PTFCE), polytetrafluoroethylene, the copolymer of tetrafluoroethylene with vinylidene fluoride, and polyethylene. The radiation effect was different for each polymer. The reversibility effect in PVC and PTFCE was associated with an accumulation of volatile products of radiolysis. The effect observed in the other polymers was connected with the formation of unstable peroxide compounds such as free radicals. (tr-auth)

16760 ELECTRONIC AND NUCLEAR STOPPING CROSS SECTIONS IN CARBON FOR LIGHT-MASS IONS OF 4.5 TO 46 keV ENERGY. Hoegberg, G. (Chalmers Univ. of Tech., Goteborg). Phys. Status Solidi (b); 48: No. 2, 829-41(1 Dec 1971).

The mean stopping cross section, $\bar{S}$, of thin carbon foils was determined for light-mass particles with $3 \leq Z_1 \leq 18$. The dependence of stopping cross section on foil thickness and scattering angle is reported. The energy of the incident ions ranged from 4.5 to 46 keV. The electronic, S_e, and nuclear, S_n, stopping cross sections were deduced from the experimentally determined mean stopping cross section at zero output angle, $\overline{S(0)} = S_e + \overline{S_n(0)}$, by putting $S_e = \lim_{t \to 0} \overline{S(0,t)}$, where t is the foil thickness. The reported values of S_e are in good agreement with previously published results. The mean nuclear stopping cross section in the forward direction is found to reach a saturation value in foils thicker than about 8 $\mu g/cm^2$. The increase of $\bar{S}$ with scattering angle is parabolic at small scattering angles and linear at large scattering angles. (auth)

16761 COMMENTS ON RESIDUAL POWER FLUXES FROM RADIOACTIVE SURFACES. Schlenker, Robert A. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 44: 115-16(Apr 1971).

Romero (Nucl. Sci. Eng., 42: 49(1970)) predicted residual fluxes of heavy particles escaping radioactive surfaces (NSA 24: 51778). Similarities between the calculations of Romero and certain dose-rate calculations of others are pointed out here. A reply by Romero is included. (L.M.T.)

Radiation Protection Standards

Refer also to abstracts 15802 and 15856.

16762 RADIATION PROTECTION STANDARDS. PART 2. Taylor, Lauriston, S. (National Council on Radiation Protection and Measurements, Washington, D. C.). CRC Crit. Rev. Environ. Contr.; 2: No. 2, 147-205(Aug 1971).

Developments in radiation protection standards since 1957 are reviewed. The setting up of the Federal Radiation Council, the change in National Council on Radiation Protection and Measurements (NCRP) relations with the National Bureau of Standards, Public Health Service Activities, and studies by National Academy of Sciences are discussed. Highlights of the reports of the NCRP and International Commission on Radiation Protection (ICRP) are reviewed. Radiation from television receivers and changes in understanding of genetic effects of radiation are discussed at length. 189 references. (M.H.R.)

Radiation Source Calibration and Standardization

16763 (CONF-680423–, pp 10–15) SPECIFICATIONS OF RADIOPHARMACEUTICALS: POSSIBLE INTERNATIONAL ASPECTS OF LABELLED COMPOUNDS PROGRAMS. Balaban, A. T. (International Atomic Energy Agency, Vienna (Austria)).

From second inter-American conference on radiochemistry; Mexico City, Mex. (22 Apr 1968).

The need for an international agreement as to the necessary specifications of radioactively labeled compounds intended for use in medicine was explored. A tentative proposal for an international set of specifications is presented. (D.H.M.)

16764 AIR/GROUND INTERFACE PROBLEM FOR DISK ISOTROPIC ^{60}Co SOURCES. Rubin, R. M. (Mississippi State Univ., State College). Nucl. Sci. Eng.; 47: No. 2, 221–4(Feb 1972).

The exposure angular distributions above various ring isotropic and disk isotropic ^{60}Co sources were calculated in a constant-density air medium and compared to Monte Carlo calculations and experimental data for the same sources located at the interface between air and ground. The effect of the interface for ring sources is found to be very similar to the expected results for point sources. For disk sources, the interface effects on the exposure angular distribution are presented as a ratio that has a simple exponential dependence on the cosine of the angle. The results for a very large disk (infinite plane isotropic source) yield correction factors to the assumption that earth can be treated as condensed air. (auth)

Shielding Calculations and Theory

Refer also to abstracts 16477 and 17121.

16765 FLEXIBLE IONIZING RADIATION SHIELD BARRIERS. McCluer, John D.; Roy, Robert C. (to H. K. Porter Co., Inc.). U. S. Patent 3,622,432. 23 Nov 1971. Filed 1 Feb 1967.

Flexible ionizing radiation shield barriers are described that consist of a heavily lead-loaded elastomeric layer adhering to a fabric base, thereby forming a thick heavy flexible material useful in shielding against radiation. The lead loading comprises at least 55% by total weight of the material and contains lead particles of, at most, 200 mesh. (auth)

16766 PHYSICAL INTERPRETATION AND STRUCTURE OF BUILD-UP FACTOR ASYMPTOTIC AND TRANSIENT COMPONENTS FOR MULTI-LAYER SHIELDS. Zharkov, V. A. At. Energ. (USSR); 31: No. 5, 481–6(Nov 1971). (In Russian).

Physical interpretations and mathematical expressions for the asymptotic and transient components of the buildup factor for multilayer shields relating different types of sources are presented. It is shown that there exists such an optimum solution that the contribution of the transient component to the integral buildup factor is minimum. The asymptotic expressions for the buildup factor are noted to have an independent practical value, particularly in the optimum case. (auth)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 15304, 15598–15604, 15728, 15846, and 15850.

16767 (AECL–4065) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1971. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Oct 1971. 107p. (PR-CMa–18). Dep. NTIS (U. S. Sales Only). AECL $2.50.

16768 (BNWL-tr–68) DEFECT PRODUCTION RATES AND DISPLACEMENT CROSS SECTIONS IN METALS AND ALLOYS UNDER IRRADIATION IN REACTORS AND ACCELERATORS. Ehrlich, K.; Kaletta, D.; Schneider, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated for Battelle Pacific Northwest Labs., Richland, Wash., from report KFK–1438. 22p. Dep. NTIS.

Calculations are made of radiation damage in metals and alloys from different reactor spectra and particles. Equations are derived for energy transferred, displacement, and Frenkel defect production, and various potentials used for charged-particle bombardment are discussed. The results show that the EBR-II and DFR produce per dosage unit almost twice the damage rates in steels as the SNR (however, cluster formation is not taken into account). A comparison is made between the different radiations (α, Ni^+, C^{2+}, and d) and their effects on Ni, and questions in the calculations (displacement spikes, etc.) are discussed. (D.L.C.)

16769 (CEA-CONF–1888) LOW-TEMPERATURE ELECTRON MICROSCOPY APPLIED TO NEUTRON-RADIATION-DAMAGE STUDIES OF MATERIALS. Bourret, A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1971. 10p. (CONF-710916–4). Dep. NTIS (U. S. Sales Only).

From fifth international materials symposium, Berkeley, Calif. (13 Sep 1971).

The appearance and evolution of defect clusters, produced by neutron irradiation, was observed in Ni, Mg, and Al with a low-temperature electron microscope. In Ni and Fe, prior to annealing, there is no evidence of displacement spike visibility or for small clusters having diameters greater than 20 Å. In Ni, the clusters become visible at 60°K; at this temperature, interstitials may be assumed freely migrating. In Al, interstitial clusters formed during irradiation at 77°K are nearly all annealed at 230°K, i.e., during the 3rd stage; this is a direct proof that vacancy-type defects migrate at this temperature and annihilate interstitial clusters. In contrast, only a small decrease in the number and size of the clusters is observable during the 3rd stage in Mg; this is attributed to vacancy agglomeration occurring simultaneously with the annealing of interstitial clusters. (France)

16770 ION IMPLANTATION OF NITROGEN INTO CADMIUM SULFIDE. Shiraki, Y.; Shimada, T.; Komatsubara, K. F. (Hitachi Ltd., Tokyo). J. Appl. Phys.; 43: No. 1, 710-18(Jan 1972).

Ion implantation of nitrogen into n-type cadmium sulfide was investigated with energy up to 200 keV at dose levels 10^{15} to 10^{17} cm^{-2}. The measurements of I–V, C–V characteristics, and photoelectric properties of diodes made on implanted CdS gave evidence for p-type layer formation. EPR studies clarified the nitrogen center and lattice-defect centers produced by the ion implantation. Current of the implanted diodes can be expressed by $I = I_0 [\exp(eV/nkT) - 1]$ and the parameter n was remarkably reduced from 10 to 2.7 by a 10-min anneal at 400°C. Overannealing degraded the diode characteristics. The peculiar C–V characteristics and the negative photovoltage were observed for the implanted diode, which can be understood only by presuming a series structure of the p–n junction formed by nitrogen implantation and a Schottky barrier on a p-type surface. The relative spectral response of photovoltage of the diode had a peak at 800 mμ, i.e., at 0.85 eV below the band edge after annealing below 400°C. The 800-mμ peak is reasonably ascribed to implanted nitrogen ions, because of the absence of the peak in both unimplanted and neon-implanted CdS. Optical quenching level due to radiation damage produced by implantation was also observed for photocurrent of heavily implanted samples. EPR measurements assured the existence of nitrogen centers in implanted CdS. A new EPR spectrum led to the model of N_2^- molecular-ion center substitutional for sulfur ion. The center was observed after annealing at 400°C, while the density of lattice-defect centers decreased. (auth)

16771 CHANNELING OF PHOSPHOROUS IONS IN SILICON. Reddi, V. G. K.; Sansbury, J. D. (Fairchild Camera and Instrument Corp., Palo Alto, Calif.). Appl. Phys. Lett.; 20: No. 1, 30-1(1 Jan 1972).

Profiles of channeled ^{31}P ions over the energy range 30 to 600 keV were measured in ⟨100⟩, ⟨111⟩, and ⟨110⟩ Si. The maximum range R_{max} of the channeled ions is nearly the same for the ⟨100⟩ and ⟨111⟩ directions and is significantly greater for the ⟨110⟩ direction. (auth)

16772 GAMMA-RADIATION DAMAGE IN EPITAXIAL GALLIUM ARSENIDE. Brehm, G. E.; Pearson, G. L. (Stanford Electronics Labs., Calif.). J. Appl. Phys.; 43: No. 2, 568-74 (Feb 1972).

Electrical and photoluminescence measurements were carried out on liquid epitaxial GaAs single crystals after irradiation at room temperature by 1.25-MeV ^{60}Co γ rays. Following each of a series of irradiations, Hall measurements were made on both n- and p-type crystals as a function of temperature between 77 and 300°K. The n-type crystals exhibited energy levels 0.13, 0.16, and 0.30 eV below the conduction band minimum after irradiation. The 0.13- and 0.16-eV levels were introduced during irradiation at roughly one-half the rate at which compensating deep acceptors were introduced. The p-type crystals showed energy levels 0.059 and 0.10 eV above the valence band maximum. Before irradiation, these p-type crystals had energy levels in the lower 0.20-eV level of the band gap. It is, therefore, not possible to determine whether the 0.059- and 0.10-eV levels were produced by irradiation or were merely uncovered as the free-hole density was reduced by radiation-induced deep donors. The carrier removal rate at 77°K was 0.012 cm^{-1} for p-type crystals. Photoluminescence measurements on irradiated material revealed additional energy levels near the center of the band gap. (auth)

16773 INTERNAL FRICTION IN COPPER SUBJECTED TO NEUTRON IRRADIATION AND FATIGUE. Stribie, Fred C. (Hughes Tool Co., Culver City, Calif.); Cady, James R. J. Appl. Phys.; 43: No. 2, 417-24(Feb 1972).

The internal friction of pure (99.999%) annealed polycrystalline copper was studied as a function of fatigue and neutron irradiation. The fatigue was applied to wire specimens in rotating bending and the internal friction was measured at selected fatigue intervals by means of a torsional pendulum. The internal friction of unirradiated copper was found to change significantly with fatigue and the changes can be related by Granato–Lücke theory to dislocation generation, mobility, and interaction. These in turn can be related to present fatigue theories of slip zone development, dislocation pileup, and microcrack formation. The internal friction of copper subjected to fatigue after neutron irradiation is reduced due to dislocation pinning by irradiation-generated point defects, principally vacancies. Dislocation pinning in irradiated copper remains effective, in most instances, throughout the fatigue life. However, the fatigue strength of copper is not greatly changed by irradiation which suggests that the improvement in fatigue usually expected from the irradiation-induced reduction in dislocation mobility may be offset by other damaging effects of the neutron irradiation. (auth)

16774 NEUTRON DAMAGE IN SiC LIGHT-EMITTING DIODES. Barnes, C. E. (Sandia Labs., Albuquerque, N. Mex.). Appl. Phys. Lett.; 20: No. 2, 86-8(15 Jan 1972).

The effects of neutron irradiation on silicon carbide light-emitting diodes (LED's) were studied over the temperature range 76 to 300°K. The results indicate that over the entire temperature range, the radiative current in the low-voltage region is due to tunneling and subsequent radiative recombination in the depletion layer. Since this type of current is fairly radiation-resistant, it is suggested that the SiC LED is an attractive device for operation in a neutron environment. (auth)

16775 ELASTIC AND ANELASTIC BEHAVIOR OF ION-IMPLANTED SILICON. Tan, S. I.; Berry, B. S.; Crowder, B. L. (IBM Watson Research Center, Yorktown Heights, N. Y.). Appl. Phys. Lett.; 20: No. 2, 88-90(15 Jan 1972).

Ion-implantation damage was studied in thin reeds of silicon by resonant-frequency and internal-friction measurements. For a dose of $10^{16}/cm^2$ of $^{28}Si^+$, the principal effects are the appearance of an internal-friction peak and a decrease in the flexural vibration frequencies. The amorphous surface layer produced by implantation is deduced to have a Young's modulus of 1.24×10^{12} dyn/cm^2 and a density of 0.95 of the crystal density. The internal stress in the amorphous layer was measured and found to be far

smaller than that corresponding to a purely elastic accommodation of the density change. (auth)

16776 ^{17}O HYPERFINE INTERACTION OF THE V_F CENTER IN MgO. Schoenberg, A. (Israel Atomic Energy Commission, Yavne, Israel); Suss, J. T.; Szapiro, S.; Luz, Z. Phys. Rev. Lett; 27: No. 24, 1641-3(13 Dec 1971).

An ESR study of V_F centers in γ-irradiated single crystals of MgO enriched in ^{17}O is reported. The ^{17}O hyperfine tensor components are found to be $|t_{\parallel}^{17}| = 104.5 \pm 0.5$ G and $|t_{\perp}^{17}| = 14.5 \pm 0.5$ G. From these results and those for $g_{\parallel}$ and $g_{\perp}$, two parameters of the O^- ion in MgO are determined: The hyperfine interaction parameter α^{17} is found to be 22.8 G and the average of r^{-3} over the 2p orbital is $\langle r^{-3} \rangle_{2p} = 2.75 \times 10^{25}$ cm^{-3}. (auth)

16777 EFFECTS OF Al FILMS ON ION-IMPLANTED Si. Lee, D. H.; Hart, R. R.; Marsh, O. J. (Hughes Research Labs., Malibu, Calif.). Appl. Phys. Lett.; 20: No. 2, 73-5(15 Jan 1972).

Ion-implanted amorphous regions of Si in the presence of Al films 300 to 700 Å thick are found to recrystallize between 325 and 350°C. This recrystallization occurs at a temperature significantly below both the epitaxial regrowth of the amorphous Si (~600°C) and the Al–Si eutectic of 577°C. In the case of the 300-Å metallizations, the enhanced low-temperature reordering of the damaged layer is simultaneously accompanied by an interfacial migration, which results in Si transport to the surface of the sample. The observed phenomena are analyzed as a function of anneal temperature by 280-keV α-particle backscattering and 1.8- to 6.2-eV optical reflectance measurements. (auth)

16778 ENHANCED MIGRATION OF IMPLANTED Sb AND In IN Si COVERED WITH EVAPORATED Al. Hart, R. R.; Lee, D. H.; Marsh, O. J. (Hughes Research Labs., Malibu, Calif.). Appl. Phys. Lett.; 20: No. 2, 76-7(15 Jan 1972).

Amorphous layers of Si produced by the bombardment of Sb^+ and In^+ and covered with ~400 Å of Al show pronounced migration of the implanted atoms to the Si/Al interface and the Al surface after a 350°C anneal. This enhanced migration occurs simultaneously with the recrystallization of the amorphous layer. Low-temperature migration effects are not seen in uncoated amorphous Si, nor on reordered Si covered with evaporated Al. The depth distribution of the implanted atoms is measured by backscattering analysis with 280-keV α particles. (auth)

16779 EFFECT OF FAST-NEUTRON IRRADIATION ON THE INFRARED ABSORPTION SPECTRUM OF CRYSTALLINE SILICA IN THE 3-μ REGION. Zubov, V. G.; Osipova, L. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 12: No. 3, 282-5 (May-Jun 1971). (In Russian).

A comparison of the optical density of infrared absorption bands was made in the 3-μ region on samples of crystalline quartz that had been irradiated with fast neutrons in the following doses: (0.4, 3.0, 3.5, and 6.0) $\times 10^{19}$ n/cm^2. Saturation of the band at 3,600 cm^{-1} was observed in quartz after exposure to an integral flux of 0.4×10^{19} n/cm^2. A gradual shift in the maximum of this band was noted in the short-wavelength region with greater radiation doses. The mechanism of the behavior of the defect was considered. (tr-auth)

16780 CHANNELING OF LIGHT IONS IN MONOCRYSTALS OF W, Mo, AND Cu. Arifov, U. A.; Khadzhimukhamedov, Kh. Kh.; Yunusov, A. I. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 60-3(1971). (In Russian).

The scattering coefficient of ions was studied as a function of type, energy, ion diameter, mass of target atoms, and parameters of the crystalline lattice in the case of loose faces (112) for monocrystals of W, Mo, Cu, and Si. For more dense faces, (122) was frequently used. The scattering coefficient with respect to any given ion decreased as the target atom decreased in mass: $W_{(112)} > Mo_{(112)} > Cu_{(112)} > Si_{(112)}$. The ratio of the diameter of any channeling ion to the channel width of any monocrystal was practically constant: $d_{Na^+}/l_{Cu(112)} = 0.77$, $d_{Li^+}/l_{W(112)} = 0.78$, and $d_{Li^+}/l_{Mo(112)} = 0.79$. (K.S.W.)

16781 EFFECT OF REACTOR RADIATION ON THE MOBILITY OF DISLOCATIONS IN GERMANIUM. Zotova, L. G.; Khiznichenko, L. P. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 91-4(1971). (In Russian).

The mobilities of discrete dislocations in monocrystals of germanium were measured before and after neutron irradiation. Small plates were excised from a p-type Ge monocrystal with specific resistance of one ohm · cm and an initial density of dislocations of 100/cm^2. These plates were irradiated in a reactor at 40 and 300°C at a flux of 1.38×10^{13} n/cm^2 · sec. The mobility of screw (Burgers) dislocations at temperatures below 440°C was reduced by neutron radiation; at 440°C, however, this effect vanished. (K.S.W.)

16782 CHANGE IN THE COERCIVE FORCE OF THE ALLOY Ni_3Mn IN A FIELD OF POWERFUL GAMMA-RADIATION AT 200 TO 400°C. Shalaev, A. M.; Krulikovskaya, M. P.; Danil'chenko, B. A. (Inst. of Metal Physics, Moscow. Inst. of Physics, Moscow). Fiz. Metal. Metalloved.; 32: No. 1, 193-4(Jul 1971). (In Russian).

The effect of a strong field of γ radiation on the magnetic properties of the intermetallic compound Ni_3Mn was studied at 200 to 400°C, after removing any preliminary ordering in the material by subjecting it to 66% tensile strain, and then quenching from 1000°C to promote the formation of new ordered centers. In the presence of γ radiation, the coercive force rose to much higher values than in its absence, e.g., 35 instead of 20 Oe after 1 hr at 250°C. These effects were attributed to accelerated ordering under irradiation. (Metals Abstr.)

16783 LATERAL DIMENSIONS OF TRACKS OF PROTONS AND ALPHA PARTICLES IN A CRYSTAL OF NaCl. Vaisburd, D. I.; Melikyan, L. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 151-3(1971). (In Russian).

Effective widths of proton and α-particle tracks were determined by the use of conversion kinetics of radiation defects. Plates of a monocrystal of NaCl were irradiated at room temperature with low-energy protons or α particles that penetrate to a given depth. Electron and hole color centers are formed; calculations are based on the F_1 and F_2 centers. The effective track radius of a proton was found to be 74 ± 5 Å, that for an α particle 155 ± 15 Å. (K.S.W.)

16784 ELECTRICAL CONDUCTIVITY AND DIELECTRIC BREAKDOWN PHENOMENA IN METAL OXIDE INSULATORS. Britt, Edward Joseph. Tucson, Ariz.; Univ. of Arizona (1971). 148p. University Microfilms Order No. 71-28,667.

Thesis.

Dielectric breakdown in alumina and beryllia were investigated theoretically and compared to previous experiments for ranges from 300 to 1200°K. Two theoretical models of electron dynamics were combined with a general energy-band model for an insulator with localized trapping centers. The effects of carrier generation, trapping, collision multiplication, and recombination are all considered. The first model treats dielectric breakdown caused by an electron avalanche. A swarm of electrons moves through the material under the electric field. The electron density in the swarm may increase through collision ionization. A Boltzmann-type of equation is used to relate the processes involved with the conservation of particles and the particle motion in the swarm. The equations were solved, together with appropriate boundary conditions, to calculate the maximum density attained by an electron swarm for a given electric field. If the density in the electron avalanche reaches a certain critical size, energy deposition in the crystal will cause permanent disruption and dielectric breakdown. Iterative calculations are made for a range of material temperatures both in and out of a flux of high-energy x-ray photons. The results are in quantitative agreement with experiments on Al_2O_3 and BeO in front of a 1-MeV electron accelerator used as an x-ray source. The second model analyzes thermal breakdown at higher temperatures. For these calculations, a lumped-parameter heat balance was devised to obtain a differential equation for the time behavior of the temperature in the breakdown region. The breakdown region undergoes Joule heating by the leak current and loses heat to the insulating material and surroundings. Feedback enters through electrical conductivity which is strongly dependent on temperature, owing to thermal generation of carriers as well as electron trapping and recombination. The coupled set of differential equations was analyzed to determine the maximum electric field for which a stable solution of the system exists, and this field is then taken as the breakdown field. A single lumped-parameter constant, which includes all thermal and geometric parameters, is determined by normalizing the equations to fit experimental data at one temperature. The breakdown field can then be predicted by the thermal model for a variety of sample thicknesses at 500 to 1300°K. Iterative solutions are obtained on a digital computer for both irradiated and unirradiated conditions. Calculated results of thermal breakdown agree with experiments for Al_2O_3 and BeO for temperatures above 500°K. The results of avalanche model calculations are in agreement with experiments at the lower temperatures. (TSS) (Diss. Abstr. Int., B)

16785 STUDY OF COLOR CENTERS APPEARING IN A STRONTIUM CHLORIDE CRYSTAL DOPED WITH AN ALKALI-METAL ION. Baltog, I.; Lefrant, S.; Houlier, B.; (and others) (Paris Univ., Orsay, France). Phys. Status Solidi (b); 48: No. 1, 345-52(1 Nov 1971). (In French).

After irradiation by x rays, an ESR signal is observed that can be attributed to V_k centers oriented along the [100] directions. The optical absorption spectrum can be attributed to the V_k center, to perturbed F* centers, and to associations of F centers. The width of the ESR lines is attributed to a supplementary hyperfine interaction with alkali-metal cations. This interaction disappears by warming the crystal to 160°K; the mobility of the positive holes at this temperature can explain this result. After heating, the perturbated F* centers give associations; then they disappear and normal F centers are obtained. The model suggested interprets the results obtained in CaF_2: Na^+ after irradiation by x rays. (auth)

16786 INVESTIGATION OF ANNEALING IN ELECTRON-IRRADIATED TUNGSTEN. Kunz, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart). Phys. Status Solidi (b); 48: No. 1, 387-98(1 Nov 1971). (In German).

Ultra-pure, zone-refined tungsten was quenched in superfluid helium and investigated by electric-resistivity measurements. The determined energy of formation for vacancies E_{FV} was corrected for the size effect. The complex behavior of isochronal and isothermal annealing curves suggests that vacancy clustering occurs. Isochronal annealing curves following electron irradiation at 4.5°K show three stages. The enhancement of the low-temperature stage in quenched samples supports the assumption that the quenched-in defects are vacancies and not impurities. (auth)

16787 SOME SPECIAL FEATURES OF SUBTHRESHOLD RADIATION EFFECT IN SILICON. Zaikovskaya, M. A.; Kiv, A. E.; Niyazova, O. R. (Inst. of Nuclear Physics, Tashkent). Phys. Status Solidi (a); 8: No. 2, K133-5(16 Dec 1971).

B-doped p-type Si single crystals were irradiated by 16- and 100-keV electrons between 90 and 380°K. The temperature dependence of the defect production is shown on a $\Delta R/R_0\phi$ vs T plot, where R_0 = initial resistance and ϕ = electron flux. The maximum production rate occurs between 140 and 200°K. Variation of the B concentration showed a proportionality between the defect production rate and the hole concentration. The energy level of defects produced by electrons up to 20 keV was estimated to be $E_V + 0.2$ eV. (D.L.C.)

16788 RADIATION ORDERING. Novak, L. I. Fiz. Metal. Metalloved.; 31: No. 5, 925-9(May 1971). (In Russian).

Transitional processes taking place in ordered and partially ordered alloys under the influence of fast neutrons or other penetrating radiations are discussed from the theoretical point of view. A simplified theory of neutron scattering, covering most of the radiation ordering processes likely to take place in existing alloys, is presented. The theory is qualitatively supported by measurements made on irradiated Ni–Mn alloys containing the ordered phase Ni_3Mn. Possible extensions of the theory are considered. (Metals Abstr.)

16789 NON-STATIONARY RADIATION-ENHANCED DIFFUSION IN METALS. ORDERING IN THE COLD-WORKED SILVER–ZINC ALLOYS. Bystrov, L. N.; Ivanov, L. I.; Platov, Yu. M. (Inst. of Metallurgy, Moscow). Phys. Status Solidi (a); 8: No. 2, 375-81(16 Dec 1971).

A model is proposed for the nonstationary radiation-enhanced diffusion in metals containing a significant concentration of unsaturable sinks for radiation point defects. By measuring the change of resistivity at −197°C, ordering in the cold-worked samples of the Ag–8.75 at% Zn alloy was investigated under 2.3-MeV electron irradiation with flux of 9.35×10^{12} to 3.74×10^{13} cm^{-2} sec^{-1} at temperatures from 10 to 35°C. It is found that the radiation-enhanced diffusion in metals containing a considerable number of dislocations (unsaturable sinks) is a nonstationary process with a diffusion coefficient gradually decreasing with time in accordance with the equation derived for the nonstationary radiation diffusion. The validity of the model proposed for the nonstationary radiation-enhanced diffusion controlled by the motion of interstitials is confirmed also by the fact that the radiation ordering is temperature-independent and proportional to the square root of irradiation flux. (auth)

16790 RADIATION-INDUCED INCREASE OF THE 100°C THERMOLUMINESCENCE SENSITIVITY OF FIRED QUARTZ. Zimmerman, J. (Oxford Univ.). J. Phys., C (London); 4: No. 18, 3265-76(31 Dec 1971).

The 100°C thermoluminescence (TL) sensitivity of fired quartz is increased greatly by beta irradiation and subsequent heating (e.g., by an order of magnitude following a 1-krad dose and heating to 500°C). Its radioluminescence response increases similarly, implying that the increase of TL sensitivity arises from an increased probability of photon emission per thermally released charge. This implication is confirmed by the decrease of thermally stimulated exoelectron emission (TSEE) sensitivity which accompanies the increase of the TL sensitivity. Furthermore, the decrease of TSEE sensitivity shows that the increased TL sensitivity arises from an intrinsic change in the luminescence centers themselves, rather than from some cause external to the luminescence centers. The increase of TL sensitivity is reduced by uv irradiation, and restored by subsequent heating to 500°C. These results indicate that the increase of TL sensitivity results primarily from an increase in the number of activated luminescence centers participating in TL emission, the centers being activated by charge capture. (auth)

16791 INFLUENCE OF ION BOMBARDMENT ON MOS-STRUCTURE PROPERTIES. Zorin, E. I.; Pavlov, P. V.; Popov, Yu. S.; Tulovchikov, V. S.; Shitova, E. V. (Physical Technical Inst., Gorky, USSR). pp V231-42 of International Conference on the Physics and Chemistry of Semiconductor Heterojunctions and Layer Structures. Vol. V. /Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971).

From International conference on the physics and chemistry of semiconductor heterojunctions and layer structures; Budapest, Hungary (11 Oct 1970).

Si–SiO_2 structures were bombarded with 25-keV P and Ar ions. The effects on the CV- and GV-characteristics and on the surface-state charge N_{ss} and density of interface states D were determined. The effects of the ion energy on the changes in N_{ss} and D were studied. Thermal and uv-light annealing of the charges were also studied. Measurements of the contact potential difference were made. The results show that ion bombardment causes accumulation of hole traps, that at some doses and energies the induced charge begins to decrease, and that at some doses and energies the density of interface states not annealed out grows sharply. (D.L.C.)

16792 ANALYSIS OF THIN SURFACE LAYERS AND IMPURITY PROFILES BY BACKSCATTERING AND CHANNELING OF MeV HELIUM IONS. Gyulai, J. (California Inst. of Tech., Pasadena); Mitchell, I. V.; Mayer, J. W.; Rodriguez, V. pp V293-301 of International Conference on the Physics and Chemistry of Semiconductor Heterojunctions and Layer Structures. Vol. V. /Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971).

From International conference on the physics and chemistry of semiconductor heterojunctions and layer structures; Budapest, Hungary (11 Oct 1970).

A selective review is presented of the use of MeV He ion backscattering and channeling for analysis of semiconductor structures. A brief indication is given of the type of information contained in the backscattering spectrum. The data reviewed include Si epilayers on Si and spinel, GaAs covered by Ge and Au layers, SiO_2 and Si_3N_4 layers on Si, and Al_2O_3 on Si single crystal. (D.L.C.)

16793 METHOD AND APPARATUS FOR ION BOMBARDMENT USING NEGATIVE IONS. (to Applied Research Lab., Inc.). British Patent 1,259,505. 5 Jan 1972. Priority date 22 Apr 1968, United States.

The proposed method of implanting particles of atomic dimensions in a specimen of an electrically insulating material is based on bombardment of the material by negatively charged ions. The same method of bombardment by negatively charged ions can be used for sputtering of electrically insulating material and for analysis if a mass spectrometer is used to identify the sputtered ions. (A.G.W.)

16794 ROLE OF IMPURITIES OF GROUPS III AND V IN THE FORMATION OF DEFECTS FOLLOWING γ IRRADIATION OF GERMANIUM. Gershenzon, E. M.; Gol'tsman, G. N.; Emtsev, V. V.; (and others) (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 14: No. 6, 241-3(20 Sep 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 6, 360-3(20 Sep 1971).

The temperature dependences of the Hall coefficient and of the photoconductivity were used to determine the concentrations of the group-V donors and group-III acceptors. Samples of Ge doped with P, As, Sb, or Bi were irradiated by γ rays at different doses up to the limiting state (p-type). The concentration of the V donors decreases with irradiation, indicating the formation of vacancy–donor complexes, while the concentration of the acceptors remains the same. The electronic states of the complexes lie in the valence band. Vacancy–acceptor complexes are not formed in Ge, and vacancies in Ge have three charge states: −2, −1, and 0. (D.L.C.)

Physical Properties

Refer also to abstracts 15593, 15759, 15787, 15790, 15803, 15825, 15828, 16117, 16119, 16120, 16441, 16472–16475, and 17084.

16795 (BNL-16247) EXCHANGE INTERACTIONS IN EuO AND EuS. Passell, L. (Brookhaven National Lab., Upton, N. Y.); Dietrich, O. W.; Als-Nielsen, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1971. 5p. (CONF-711108-10). Dep. NTIS.

From seventeenth annual conference on magnetism and magnetic materials; Chicago, Ill. (16 Nov 1971).

Inelastic neutron scattering techniques were to measure the spin-wave dispersion curves within the first Brillouin zone of polycrystalline EuO and EuS. Least-squares-fitted values of the n.n. and n.n.n. exchange constants J_1 and J_2 are in fair agreement with previously reported results in the case of EuS. In EuO, however, J_2 is found to be ferromagnetic in agreement with a recent estimate by Kasuya but in contradiction to the previously measured antiferromagnetic n.n.n. coupling. (auth)

16796 (UCRL-73466) IMPERFECTIONS AND MICROSTRUCTURE. Mitchell, Jack B. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Nov 1971. 103p. (CONF-710902-7). Dep. NTIS.

From fourth annual meeting of the international metallographic society; Denver, Colo. (21 Sep 1971).

Basic descriptions are presented of the nature and behavior of structural imperfections (point, line, and planar), and the role of these imperfections in developing some of the microstructural features observed in crystalline materials is illustrated. Some characteristic surface microstructural features produced by imperfections are shown, but the emphasis is on microstructures observed by transmission electron microscopy. (D.L.C.)

16797 ION-CHANNELING STUDIES OF EPITAXIAL LAYERS. Picraux, S. T. (Sandia Labs., Albuquerque, N. Mex.). Appl. Phys. Lett.; 20: No. 2, 91-3(15 Jan 1972).

Depth and temperature dependences of ion channeling were used to characterize 1- to 4-μm Si layers on spinel substrates ($Al_2O_3 \cdot MgO$). Profiles of the density of crystal imperfections in the Si layers were calculated from the channeling spectra. The imperfections are greatest near the interface, and the crystalline quality improves significantly with increasing distance from the interface. This technique is particularly applicable to heteroepitaxial layers containing high densities of crystal imperfections and can be used to monitor the relative influence of growth parameters on the crystalline quality of the layers. (auth)

16798 TRANSPORT AND STRUCTURAL PROPERTIES OF VO_2 FILMS. Kwan, Clarence C. Y.; Griffiths, C. H.; Eastwood, H. K. (Superior Electronics Inc., Montreal). Appl. Phys. Lett.; 20: No. 2, 93-5(15 Jan 1972).

Transport properties of sputtered VO_2 films are shown to be critically dependent on the defect structure of this material. Measured values of thermoelectric power and Hall mobility for films deposited under optimum conditions are comparable to those previously measured on single crystals. (auth)

16799 ELECTRONIC SPECIFIC HEAT OF $Ce_xLa_{1-x}Pd_3$ TERNARY ALLOYS. Hutchens, R. D.; Rao, V. U. S.; Greedan, J. E.; Craig, R. S. (Univ. of Pittsburgh). J. Phys. Soc. Jap.; 32: No. 2, 451-4(Feb 1972).

The heat capacity of the cubic $Ce_xLa_{1-x}Pd_3$ ternary alloys was measured in the temperature range 1.5 to 10°K. The alloys consist of single phases except in the region $0.3 < x < 0.5$. These measurements supplement earlier measurements on the electric resistivity on these alloys, which had revealed the Kondo side-band effect. The specific heats for the compositions $x = 1.0$ and 0.8 were found to obey the equation $C_p = \gamma T + \beta T^3$ with a high value for γ. The heat capacities for the remaining compositions showed marked deviations from this simple relation, and exhibited well-defined minima in the C_p/T versus T^2 curves in some cases. These deviations were attributed to the influence of paramagnons. The significance of these results is discussed in terms of a model for the electronic structure of these alloys. (auth)

16800 ELECTRIC AND MAGNETIC PROPERTIES OF VANADIUM. Kostina, T. I.; Shafigullina, G. A.; Kozlova, T. N.; Kuznetsov, V. I. (Moscow State Univ.). Fiz. Metal. Metalloved.; 32: No. 1, 192-3(Jul 1971). (In Russian).

The electric resistance and magnetic susceptibility of V samples of various purities were studied at 77 to 400°K, and the results were correlated with their Hall mobilities as well as with existing data. A small kink appeared in the susceptibility curve at 240°K; a sharp break in the slope of the resistance/temperature straight line appeared at the same point, and so did a minimum value of the Hall constant. These effects were attributed to antiferromagnetic ordering below 240°K. (Metals Abstr.)

16801 ELECTRICAL CONTACTS AND CONDUCTIVITY OF MoS_2 LAYER STRUCTURES. Souder, A.; Brodie, D. E. (Univ. of Waterloo, Ont.). Can. J. Phys.; 49: No. 20, 2565-71(15 Oct 1971).

The difficulty of making electrical contact to, and obtaining meaningful data from, strongly anisotropic layer structures is discussed and clarified for MoS_2. An analysis of this anisotropy is presented and used to explain experimental results obtained from natural crystals of molybdenite. It is shown that annealed contacts on MoS_2 make good electrical contact to the crystal by diffusing the contacting material parallel to the c axis and hence making contact to all of the layers. Just below room temperatures, activation energies $\epsilon_{||}$ parallel and $\epsilon_{\perp}$ perpendicular to the c axis are 0.04 to 0.08 eV but $\epsilon_{||}$ increases to between 0.08 and 0.12 eV below approximately 200°K, with $\epsilon_{||}/\epsilon_{\perp}$ at the low temperatures between 2 and 1.5 from sample to sample. The analysis is used to show that the published data for thick and thin crystals of $MoTe_2$ can be made self-consistent. (auth) (Canada)

16802 POSSIBLE INVERTED BAND STRUCTURE IN PbPo. Dalven, Richard (Univ. of California, Berkeley). Phys. Rev. Lett.; 28: No. 2, 91-3(10 Jan 1972).

Based on empirical evidence, it is suggested that the energy band structure in PbPo may be inverted from that in PbS, PbSe, and PbTe. This inversion would result in PbPo having an L_6^+ conduction-band edge and an L_6^- valence-band edge, implying a negative value of the energy gap $E_G = [E(L_6^-) - E(L_6^+)]$, and a negative value of dE_G/dT. An experiment to test this hypothesis is proposed. (auth)

16803 OPTICAL RESONANCE IN FERROMAGNETIC GADOLINIUM. Knyazev, Yu. V.; Noskov, M. M. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 31: No. 5, 1099-1100(May 1971). (In Russian).

The optical constants of ferromagnetic Gd were measured by a polarimetric technique. On cooling the sample below the Curie point (289°K), a resonance peak appeared at 0.7 eV in the optical absorption spectrum. The peak appeared very sharply at 80°K, but at temperatures above the Curie point, it was hardly perceptible. The spectra/temperature relationship confirmed the magnetic nature of the optical anomaly in question. The mechanisms involved are considered. (Metals Abstr.)

16804 MINIMUM OF THE ELECTRICAL CONDUCTIVITY OF THE ANTIFERROMAGNETIC METAL PRASEODYMIUM. Semenenko, E. E.; Tutov, V. I. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 31: No. 5, 1096-7(May 1971). (In Russian).

Experimental data relating to the discovery of a minimum in the electric-resistance/temperature characteristics of the antiferromagnetic metal Pr are presented and compared with existing data relating to other metals. Thus, a sample containing 0.02% Fe had a minimum of the electric resistance at 0.9°K, whereas for a sample containing 0.035% Fe, the minimum was displaced to 1.8°K. The correlation between the position of the minimum and the impurity content suggested that the reasons for the effect lay in an additional scattering mechanism associated with the presence of the impurity. (Metals Abstr.)

16805 COPLANAR HALL EFFECT IN TERBIUM. Volkenshtein, N. V.; Dyakina, V. P. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 31: No. 5, 1090-1(May 1971). (In Russian).

Fresh measurements of the coplanar Hall effect (differing from the ordinary Hall effect in that the current density, magnetization, and electric-field vectors lie in the same plane) in Tb are presented and compared with existing data. Thus, on plotting the coplanar Hall coefficient as a function of temperature, a rounded maximum appears at 130°K, the absolute value at this point being slightly greater for polycrystalline than single-crystal material. Possible mechanisms underlying the effect are considered. (Metals Abstr.)

16806 SOME PARAMETERS OF THE FERMI SURFACE IN MOLYBDENUM. Boiko, V. V.; Gasparov, V. A. Zh. Eksp. Teor. Fiz.; 61: No. 5, 1976-85(Nov 1971). (In Russian).

The radio-frequency size effect in molybdenum samples cut out along the (100) and (110) planes is investigated. Anisotropy of the extreme dimensions of small parts of the Fermi surface of the metal is determined, and the shapes of electron surface of the "lens" and "spheroid" types and of hole ellipsoids are reconstructed. Current carriers with an extreme displacement over a period are observed. The values of $|\partial S/dk_H|_{exp}$ are measured, and the cross sections of the electron jack and hole octahedron to which the carriers belong are found. (auth)

16807 ELECTRON-MAGNON SCATTERING IN ERBIUM SINGLE CRYSTALS. Volkenshtein, N. V.; Dyakina, V. P.

(Inst. of the Physics of Metals, Sverdlovsk, USSR). Zh. Eksp. Teor. Fiz.; 61: No. 5, 1913-16(Nov 1971). (In Russian).

The specific electric resistance of an erbium single crystal is measured along the [0001] (axis c) and [1$\bar{2}$10] (axis a) directions at temperatures between 4.2 and 300°K. The magnetic part of the resistance ρ_m (T) is separated out. Anisotropy of ρ_m in the paramagnetic region is discussed, and the dependence of ρ_m (T) at low temperatures is considered. (auth)

16808 INVESTIGATION OF FIELD EMISSION FROM TUNGSTEN IN NANOSECOND REGION. Fursei, G. N.; Antonov, A. A.; Gulin, B. F. Vestn. Leningrad. Univ., No. 10, Fiz., Khim.; No. 2, 71-4(May 1971). (In Russian).

Field emission from tungsten monocrystals was investigated in the nanosecond region (pulse duration is 5×10^{-9} to 3×10^{-8} sec). Top current density was about 10^9 A/cm^2. Field-emission patterns in the prebreakdown stage were obtained with an electron-optical transformer. The field-emission breakdown transition was found to consist of several stages, such as primary tip destruction caused by the field emission current, followed by increase in electron current during breakdown and tip erosion. (auth)

16809 ELECTRON TRANSFER AND ELECTRICAL PROPERTIES OF THE BINARY SYSTEMS Hg–Tl AND Tl–In. Belashchenko, D. K.; Gushchina, E. I.; Omarova, K. D. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 31: No. 5, 930-8(May 1971). (In Russian).

Electron transfer was investigated in the Hg–Tl system at 300°C and in the Tl–In system at 380°C. The electrical resistance of Tl–In solutions at 380°C were also measured. The Fermi level function was calculated from the data thus obtained and its values were tabulated relative to the composition of the system (at. wt %). (tr-auth)

16810 ELECTRICAL AND MAGNETIC PROPERTIES OF ALLOYS OF SOME RARE-EARTH METALS. Vedernikov, M. V.; Guts, Z. A. pp 86-91 of Redkozemel'n. Metally i ikh Soedin. Kiev; Naukova Dumka (1970). (In Russian).

Measurements were made of the concentration dependence of electrical resistance, the magnetic moment of the Pr atom, and the thermo-emf of La–Pr and Nd–Pr alloys over the whole range of compositions. On the La and Nd sides, the concentration dependence curve for electrical resistance is below the line corresponding to an addition characteristic. In Pr-rich systems, the curve has the usual dome shape. An increase in the Pr magnetic moment occurs in the concentration region in which the La–Pr alloys have an anomalous electrical resistance. (Referativnyi Zh.)

16811 ORDERED MAGNETIC STRUCTURE OF THE COMPOUND DyCu. Wintenberger, M. (CNRS, Grenoble, France); Chamard-Bois, R.; Belakhovsky, M.; Pierre, J. Phys. Status Solidi (b); 48: No. 2, 705-9(1 Dec 1971). (In French).

A powder sample of the compound DyCu was studied by neutron diffraction. The neutron data leave an indetermination between a collinear magnetic structure with moments pointing along a fourfold axis and a noncollinear structure with moments pointing along the four threefold axes. Crystal-field and dipolar energy calculations, as well as previous Moessbauer data, favor the noncollinear model. (auth)

16812 ANISOTROPIC RESISTIVITY OF SOLID CADMIUM. Toussaint, G.; Pecheur, P. (Laboratoire de Physique du Solide, Nancy). Phys. Status Solidi (b); 48: No. 2, K109-11(1 Dec 1971).

The resistivity of Cd parallel and perpendicular to the c-axis was calculated, using Ziman–Baym theory. Both Animalu and empirical form factors were used. The N-process contribution is very weak. The anisotropy ratio is higher than the experimental values. (D.L.C.)

16813 ENERGY BAND STRUCTURE OF VANADIUM, ZIRCONIUM, AND NIOBIUM MONOCARBIDES. Potorocha, V. I.; Tskhai, V. A.; Geld, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). Phys. Status Solidi (b); 48: No. 1, 119-27(1 Nov 1971).

The results of calculations of the electron energy spectrum and the contribution of atomic states to the formation of band structure of vanadium, niobium, and zirconium monocarbides based on the tight-binding method are reported. The calculations were performed in the two-center approximation, taking into account the ns and (n – 1) d-orbitals of metal atoms and 2s, 2p carbon atoms. The secular equation was solved in 214 points, 1/48th of the Brillouin zone. A discussion of results and their comparison with experimental data are presented. (auth)

16814 ELASTIC ENERGY OF A STRAIGHT DISLOCATION IN AN INFINITE ANISOTROPIC ELASTIC MEDIUM. Barnett, D. M.; Swanger, L. A. (Stanford Univ., Calif.). Phys. Status Solidi (b); 48: No. 1, 419-28(1 Nov 1971).

An expression for the elastic energy per unit length of a straight dislocation in a medium of arbitrary anisotropy is derived in a form simply suited for numerical calculations. The expression utilizes laboratory coordinates throughout and, unlike previous analyses, its evaluation does not rely upon solving the roots of a sextic algebraic equation. Numerical results are presented for glide dislocations in three cubic metals of low, intermediate, and large anisotropy—niobium, copper, and lithium. (auth)

16815 CATALYSIS ON BINARY ALLOYS OF THE TRANSITION METALS. A CONTRIBUTION TO THE ENGEL–BREWER THEORY. Zettler, H.; Schwab, G.-M. (Univ., Munich). Z. Phys. Chem. (Frankfurt); 76: No. 1–2, 38-49(Oct 1971). (In German).

A study was made to determine whether a relation exists between the electron configuration of binary alloy elements, as postulated by the Engel–Brewer theory, and the catalytic properties of these systems. The binary alloys of the transition metals Cr–Rh, Mo–Rh, Mo–Ir, W–Rh, and W–Ir were investigated. After determination of the crystal structure, the mechanical hardness (Brinell hardness) was determined and the density was measured. The catalytic properties were determined on the basis of formic acid dehydration. No direct relation between activation energy and the electron or geometric factors could be detected. (tr-auth)

16816 MAGNETIC PHASE TRANSITIONS IN THE UAs–USe SYSTEM. Leciejewicz, J. (Inst. of Nuclear Research, Warsaw); Troc, R.; Murasik, A.; Palewski, T. Phys. Status Solidi (b); 48: No. 1, 445-52(1 Nov 1971).

The transition between antiferromagnetic UAs and ferromagnetic USe was studied by neutron diffraction. The addition of Se to UAs produces a rapid disappearance of the high-temperature magnetic phase of UAs (type I) and a stabilization of the low-temperature magnetic modification (type IA). When the amount of Se further increases, four transient magnetic structures appear graudally. All are cosinusoidally modulated along the c-axis with periodicity c/2. Their magnetic unit cells are N multiples of the fcc chemical unit cells along one direction: N = 5, 7, 9, and 11. The stability ranges of all magnetic phases present in the solid solution UAs–USe and their corresponding Néel points were determined. (auth)

16817 COMMENTS ON THE TEMPERATURE RELAXATION IN METALS BY J. VAN DEN SYPE. Kraftmakher, Ya. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Phys. Status Solidi (b); 48: No. 1, K39-43(1 Nov 1971).

J. Van den Sype's (Phys. Status Solidi, 39: 659(1970)) interpretation of the author's specific heat measurements (Kraftmakher et al., Fiz. Tverd. Tela, 4: 2271(1962)) on tungsten by the modulation method is based on the assumption that the vacancy concentration did not reach equilibrium during the temperature oscillations. This interpretation is shown to be incorrect. The vacancy mechanism for the specific heat rise is discussed, and the use of relaxation at high frequencies to study vacancies is suggested. (D.L.C.)

16818 ELECTRICAL RESISTANCE AND EMISSION PROPERTIES OF METALS AT HIGH TEMPERATURES. Kraev, O. A.; Evgen'ev, N. A. pp 139-43 of Teplofiz. Svoistva Tverd. Veshchestv. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The electrical resistance and emission properties of W, Mo, and other elements were determined in the range 800 to 2400–3000°C. Cylindrical specimens 300 mm long and 1.0 mm dia were heated by a constant current in vacuum. Measurements were made of the current flowing through the specimen, the voltage drop across the working section, and the temperature. (Referativnyi Zh.)

16819 INTERMEDIATE STAGE IN THE MAGNETIC ORDERING OF EUROPIUM, IRON, AND NICKEL. Bartis, F. J. (Indiana Univ., Bloomington). Scr. Met.; 5: No. 10, 883-7(Oct 1971).

An analysis of the intermediate stage of magnetic ordering of these metals is presented in which this stage is treated as a stress-broadened first-order phase transition. A review of past research is presented in which it is noted that any broad specific heat anomaly was accepted as indicative of a higher-order phase transformation. Later, with better sample preparation and more-refined experimental techniques, it was often discovered that the transition proceeds through a two-phase region. Subsequently the transition has been reclassified as of first order. Now it must be recognized that the Ehrenfest theory of phase transformations is

too restricted. The magnetic transition in iron, for example, takes place over several hundred degrees (as shown by the specific heat), whereas the coexistence region is only 0.3 degree wide. It would be more accurate to regard this transition as a three-stage ordering reaction that proceeds discontinuously in the intermediate stage. There is a fair-sized body of evidence indicating that other types of ordering reactions involve the same three stages. A comprehensive thermodynamic theory of the ordering reaction may, therefore, be possible. (J.R.D.)

16820 MAGNETIC SUSCEPTIBILITY OF CUBIC NIOBIUM AND TANTALUM CARBIDES AT LOW TEMPERATURES. Borukhovich, A. S.; Dubrovskaya, L. B.; Matveenko, I. I.; Gel'd, P. V. Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial; No. 20, 71-3(1970). (In Russian).

The magnetic susceptibilities of cubic NbC and TaC were measured at cryogenic temperatures and compared with the values obtained under ambient conditions. Thus, a sharp rise in magnetic susceptibility occurred in carbides of almost stoichiometric composition close to the critical superconducting temperature. In the case of $NbC_{0.8}$ the susceptibility obeyed an equation of the Curie–Weiss type below 30°K. The actual susceptibility values varied widely according to the composition of the carbides, the effective values at 0°K sometimes being positive and sometimes negative. (Metals Abstr.)

16821 EFFECTS OF IRON AND MOLYBDENUM ADDITIONS ON THE PROPERTIES OF NEW HIGH MAGNETIC PERMEABILITY ALLOYS NIMALLOY. Masumoto, Hakaru; Murakami, Yuetsu; Hinai, Masakatsu (Research Inst. of Electric and Magnetic Alloys, Sendai). Trans. Jap. Inst. Metals; 12: No. 6, 396-400(Nov 1971).

Since the original discovery (Trans. Jap. Inst. Metals, 8: 49 (1967)) that Ni–Mn alloys containing about 24% Mn or less show high permeability when subjected to a proper heat treatment, much work has been carried out to investigate the effects of additions of various elements on the special characteristics of the high-permeability alloys in the Ni–Mn system named "Nimalloy." The experiments have achieved good results in producing a number of excellent magnetic alloys. It has become clear that Ni–Mn–Fe alloys should be cooled as rapidly as possible and Ni–Mn–Mo alloys as slowly as possible to develop their excellent magnetic properties. As in the case of Ni–Mn–Fe–Cr alloys, it was expected that Ni–Mn–Fe–Mo alloys would exhibit excellent magnetic properties when treated at an intermediate cooling rate. A detailed investigation confirmed that excellent magnetic alloys in the quaternary system can be produced by a moderate cooling rate at the level of furnace cooling. The highest initial permeability of 46,540 was obtained on the alloy composed of 76.88% Ni, 11.22% Mn, 4.67% Fe, and 7.23% Mo, cooled from 900°C at a rate of 400°C/hr, and the highest maximum permeability of 270,000 on the alloy of 77.13% Ni, 10.66% Mn, 5.15% Fe, and 7.06% Mo, cooled from 900°C at 2800°C/hr. The latter alloy has a coercive force of 0.0019 Oe and a magnetic hysteresis loss of 0.53 erg/cm^3 cycle, its electrical resistivity being 89.4 $\mu\Omega$-cm (20°C). (auth)

16822 EXPERIMENTAL OBSERVATION OF ROTATION OF THE PLANE OF LINEAR POLARIZATION OF γ QUANTA IN MAGNETIZED FERROMAGNETS. Lobashev, V. M.; Popeko, L. A.; Smotritskii, L. M.; Serebrov, A. P.; Kolomenskii, E. A. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 14: No. 6, 251-3(20 Sep 1971).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 14: No. 6, 373-6(20 Sep 1971).

The Faraday effect was investigated using 228- and 294-keV γ rays passing through Fe or permalloy plates magnetized in the γ propagation direction. The angle between the magnetization direction and the γ-quantum momentum was either 30 or 75°. The γ quanta passing through the plates were scattered by a polyethylene scatterer and registered by a Ge(Li) detector and a multichannel analyzer. The rotation angle of the polarization plane $\Delta\alpha$ per 1 cm of the magnetized ferromagnet was $(4.25 \pm 0.16) \times 10^{-3}$ rad for 230-keV γ rays, and $(4.70 \pm 0.3) \times 10^{-3}$ rad for 290-keV γ rays at $B_{sat} \approx 21.5$ kG. The results are in agreement with calculated values. (D.L.C.)

16823 MAGNETIC BEHAVIOR OF HOMOGENEOUS α-PALLADIUM–TUNGSTEN ALLOYS. Khan, H. R.; Raub, Ch. J. (Research Inst. for Noble Metals and Metal Chemistry, Schwaebisch-Gmuend, Ger.). Naturwissenschaften; 58: No. 11, 565(Nov 1971). (In German).

Magnetic measurements in α-Pd–W mixed crystals yielded a magnetic anomaly. When W was added to Pd, the atomic susceptibility of the Pd was strongly reduced until a minimum was reached at 12 at. % W. Further increase in the percentage of W produced a moderate increase in the susceptibility. The heat-treatment history is important in obtaining these results. (K.S.W.)

16824 INTERNATIONAL CONFERENCE ON THE PHYSICS AND CHEMISTRY OF SEMICONDUCTOR HETEROJUNCTIONS AND LAYER STRUCTURES. VOLUME I. PREPARATION AND STRUCTURE OF HETEROJUNCTIONS. Proceedings of the Conference, Budapest, 11–17 October 1970. Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971). 392p. (CONF-701060–(Vol.I)).

Thirty-five papers are presented on the preparation and structure of junctions in which the base material differs from that of the subsequent layers. Some of the topics discussed are superlattices, GeSi on Ge and Si layers, graded energy gaps, heteroepitaxy, various compound semiconductors, surface and interface properties, tunneling, epitaxial layers, switching behavior, and possible applications. (D.L.C.)

16825 INTERNATIONAL CONFERENCE ON THE PHYSICS AND CHEMISTRY OF SEMICONDUCTOR HETEROJUNCTIONS AND LAYER STRUCTURES. VOLUME II. ELECTRICAL AND OPTICAL PROPERTIES OF HETEROJUNCTIONS. Proceedings of the Conference, Budapest, 11–17 October 1970. Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971). 465p. (CONF-701060–(Vol.2)).

Thirty-eight papers are included that treat such topics as: luminescence; photoeffects; light emission; electric properties; reflection; inversion layers; epitaxial, compound, tunnel and isotype heterojunctions; photoelectric and photovoltaic properties; optoelectronic properties; charge carrier transfer; etc. (D.L.C.)

16826 INTERNATIONAL CONFERENCE ON THE PHYSICS AND CHEMISTRY OF SEMICONDUCTOR HETEROJUNCTIONS AND LAYER STRUCTURES. VOLUME III. PREPARATION AND STRUCTURE OF THIN FILM SEMICONDUCTORS. Proceedings of the Conference, Budapest, 11–17 October 1970. Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971). 286p. (CONF-701060–(Vol.3)).

Twenty-six papers are included that cover such topics as: MOS, amorphous and single-crystal films, growth, electric and optical properties, epitaxy, etc. (D.L.C.)

16827 INTERNATIONAL CONFERENCE ON THE PHYSICS AND CHEMISTRY OF SEMICONDUCTOR HETEROJUNCTIONS AND LAYER STRUCTURES. VOLUME IV. ELECTRICAL AND OPTICAL PROPERTIES OF THIN FILM SEMICONDUCTORS. Proceedings of the Conference, Budapest, 11–17 October 1970. Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971). 271p. (CONF-701060–(Vol.4)).

Twenty-six papers are presented on the following topics: single-crystal and amorphous films on substrates, dielectric properties, photoelectric and photovoltaic effects, doping profiles, factors affecting electrical properties, etc. (D.L.C.)

16828 INTERNATIONAL CONFERENCE ON THE PHYSICS AND CHEMISTRY OF SEMICONDUCTOR HETEROJUNCTIONS AND LAYER STRUCTURES. VOLUME V. PREPARATION AND PROPERTIES OF MOS AND MIS STRUCTURES. SUPPLEMENTARY SECTION. Proceedings of the Conference, Budapest, 11–17 October 1970. Szigeti, G. (ed.). Budapest; Akademiai Kiado (1971). 380p. (CONF-701060–(Vol.5)).

Thirty-nine papers are presented on the following topics: metal/insulator devices, interface properties, metal/dielectric/semiconductor structures, miniature-avalanche MOS diodes, MNS structures, band splitting, hysteresis, defects, electrical and electronic properties, charge carriers, photoelectromagnetic effect, photovoltaic effect, backscattering-channeling analysis of doped layers, tunnel structures, Schottky diodes, Cu/Nb/Cu superconducting junctions, etc. Separate abstracts were prepared for four of the papers. (D.L.C.)

For abstracts of individual papers see: 15344, 16453, 16791, and 16792.

16829 QUANTUM ABSORPTION OF THIN FILMS OF V AT LOW ENERGIES. Chassaing, Gerard; Sigrist, Maurice (Univ., Marseille). Compt. Rend., Ser. B; 273: No. 16, 753-6(18 Oct 1971). (In French).

The optical absorption $2\nu\kappa d/\lambda$ of thin films of V between 1.10 and 4.88 eV was determined. These measurements demonstrated the existence of an intense interband transition centered about 2.76 eV and sufficiently wide to almost completely mask two other transitions, occurring at 2 and 4.2 eV. These results are compared with those obtained for the bulk metal by other workers. (France)

16830 LATTICE VIBRATIONS. Donovan, B.; Angress, J. F. London; Chapman and Hall Ltd. (1971). 190p. £2.75.

The subject is considered under the following headings: atomic displacements and symmetry (crystal symmetry, Bloch's theorem and point symmetry and the Brillouin zone); classical theory of lattice dynamics (equations of motion and lattice waves, normal modes, calculation of dispersion relations, the long-wavelength

limit, the vibrational spectrum and the Debye model); quantum mechanical formulation (the adiabatic approximation, the phonon concept, creation and annihilation operators, matrix elements and quantisation of field vectors); thermal properties of crystals (thermodynamic functions, lattice specific heat, atomic amplitudes and melting, phonon–phonon interactions, thermal conductivity, and thermal expansion); dielectric properties of crystals (the dielectric constant, long-wavelength optical modes, the rigid-ion model, the polarizable ion model, the shell model, and piezoelectricity and ferroelectricity); inelastic scattering of neutrons and x rays (basic principles, general formulation of neutron scattering, coherent and incoherent scattering, coherent inelastic neutron scattering, incoherent inelastic neutron scattering, thermal diffuse scattering of x rays, and the Debye–Waller factor); photon–phonon interactions (classical dispersion theory, quantum-mechanical formulation of dipole moment, one-phonon processes, higher-order processes, transition polarizability, polarizability and dielectric constant, and Raman scattering); and the vibrations of impurities (the general problem, equations of motion for general substitutional impurities, an isotopic impurity in a linear lattice, isotopic impurities in three-dimensional lattices, and the effect of impurity vibrations on crystal properties). (UK)

16831 HEAT CAPACITY OF CERIUM–LANTHANUM AND CERIUM–LUTETIUM ALLOYS AT VERY LOW TEMPERATURES. Nikulin, E. I.; Patrikeev, Yu. B. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 6, 1527-8(Dec 1971).

Translated from Fiz. Tverd. Tela; 13: No. 6, 1824-5(Jun 1971).

The thermal capacities of antiferromagnetic Ce–9% La and Ce–10% Lu alloys were measured at 0.08 to 0.18°K. The results fit the equation $c = 2.5 \times 10^3\ T + 0.7/T^2$ erg/g·deg for Ce–9% La, and $C = 5.5 \times 10^3\ T + 0.36/T^2$ erg/g·deg for Ce–10% Lu. The effective magnetic fields at the La and Lu nuclei were determined from the nuclear thermal capacity to be 54 ± 10 kOe and 140 ± 10 kOe, respectively; they are much less than in a ferromagnetic host (Gd). (D.L.C.)

Moessbauer Effects and NMR

Refer also to abstracts 15364 and 16456.

16832 NMR STUDY OF THE α PHASE OF THE LUTETIUM–HYDROGEN SYSTEMS. Barrere, Helene; Kim Min Tran (Paris Univ.). Compt. Rend., Ser. B; 273: No. 19, 823-5(8 Nov 1971). (In French).

The width of the proton resonance line of $LuH_{0.17}$ was studied as a function of temperature. The lattice is rigid down to −8°C. The second moment was found to be 0.84 ± 0.11 G^2, the theoretical value being 0.906 G^2. Above 50°C, the protons are very energetic. The activation energy associated with the hydrogen diffusion was calculated from the line width, using the Kubo and Tomita theory (E_a = 6.40 ± 0.45 kcal/mole). (France)

16833 ATOM OF POSITRONIUM IN SOLIDS. Bartenev, G. M.; Tsyganov, A. D.; Varisov, A. Z. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 59-64(1971). (In Russian).

From studying the angular distribution of annihilated γ-quanta in quartz, it was observed that the half-width of the narrow component of correlation curves depends on the state of the substance (monocrystal, powder, glass). It is proposed that, prior to annihilation, atoms of positronium are trapped by defects (vacancies, pores, areas of lowered electron density). The half-width of the narrow component and the lifetime of the positrons depend on the characteristics of the defects (traps/collectors). Defects in the following solids are estimated according to experimental values of the half-width of the narrow component and the positron lifetime: quartz glass; powdered BeO, MgO, and Al_2O_3; and polytetrafluoroethylene. (tr-auth)

16834 STUDY OF HAFNIUM–HYDROGEN COMPOUNDS BY THE SPIN–ECHO METHOD. Khodosov, E. F.; Shepilov, N. A.; Savin, V. I. (Donetsk Physical-Technical Inst., USSR). Fiz. Metal. Metalloved.; 32: No. 1, 189-91(Jul 1971). (In Russian).

The conditions underlying the formation of a number of phases in the Hf–H system (single-phase $HfH_{1.98}$ and two-phase $HfH_{1.35}$, $HfH_{1.5}$, $HfH_{1.53}$, and $HfH_{1.84}$) were studied by the spin-echo method. The first three of the two-phase samples underwent a phase transformation into a single-phase state between 20 and 160°C, a fact not altogether obvious from x-ray analysis. The activation energy of H diffusion in the materials in question rose with increasing H content, reaching 18.7 kcal/mole in $HfH_{1.98}$. (Metals Abstr.)

16835 RELAXATION PHENOMENA DUE TO s–d EXCHANGE INTERACTION OF DILUTE IRON IN MOLYBDENUM. Maletta, H.; Rao, K. R. P. M.; Nowik, I. (Technische Univ., Munich). Z. Phys.; 249: No. 3, 189-94(1972).

It is demonstrated that the localized magnetic moments of Fe in Mo which undergo spin compensation at low temperatures via s–d exchange interaction (Kondo effect) also exhibit, at temperatures $T > T_K$, relaxation phenomena in the Moessbauer spectra due to the same exchange interaction. Utilizing the Korringa relation, the product of the exchange parameter J and the density of states $\rho(\epsilon_F)$ is estimated to be $|J\rho(\epsilon_F)| = 0.008$. At low temperatures, however, deviations from this relation have been observed. The relaxation rate becomes temperature independent and decreases with increasing external magnetic field. (auth)

16836 MOESSBAUER EFFECT IN $Fe_{17}Gd_2$ AND $Fe_{17}Nd_2$. Agarval, V. K.; Kuz'min, R. N. (Moscow State Univ.). Sov. Phys.-Cryst. (Engl. Transl.); 16: No. 4, 670-3(Jan-Feb 1972).

Translated from Kristallografiya; 16: No. 4, 774-8(Jul-Aug 1971).

An investigation was conducted of the Moessbauer effect in the nuclei of the isomorphic compounds $Fe_{17}Gd_2$ and $Fe_{17}Nd_2$ at room and (liquid-) nitrogen temperatures. For each compound four different values of H_{eff} were found, the value of which is about 300 kOe at 77°K. The features of the Moessbauer spectrum are discussed on the basis of the crystal structures of the compounds. (auth)

16837 EFFECT OF ABSORBER THICKNESS IN MEASUREMENT OF QUADRUPOLE SPLITTING IN A MOESSBAUER EXPERIMENT. Meads, R. E. (Univ. of Exeter, Eng.); Place, B. M.; Woodhams, F. W. D.; Clark, R. C. Nucl. Instrum. Methods; 98: No. 1, 29-35(1972).

It is shown that the procedure of fitting two Lorentzian lines to an experimental Moessbauer spectrum consisting of a quadrupole doublet of overlapping resonances leads to error in the measurement of line positions, and hence of quadrupole splitting, if the absorber is not thin. Two basic methods were used to obtain accurate values of quadrupole splitting from thick absorber Moessbauer spectra. The first, calculation of correction factors to the results of Lorentzian fitting the thick absorber spectra, was carried out in two ways. (1) Thick absorber spectra were simulated by computer and fitted by Lorentzian lines. Families of curves of

$$R_Q\left(\frac{\text{apparent}}{\text{true}}\ QS\right) \text{ vs } R_W\left(\frac{\text{apparent}}{\text{true}}\ \text{linewidth}\right)$$

were plotted, using the results of an experiment that can be corrected, assuming that the thin absorber linewidth is known. (2) A simple formula for correcting thick absorber data was derived, based on the assumption that a thick-absorber spectrum approximates to the sum of two Lorentzian lines, but with parameters differing from those of a thin-absorber spectrum. In the second basic method, a thick-absorber lineshape function is fitted directly to the experimental spectrum. In addition to values of quadrupole splitting, this method is shown to give an estimate of the recoil-free fraction of Moessbauer nuclei in the absorber. The methods were applied to thick-absorber quadrupole spectra of ^{119m}Sm in $Y_2Sn_2O_7$ and gave results for quadrupole splitting that are in good agreement with a thin absorber measurement. A value for the recoil-free-fraction of ^{119m}Sm in $Y_2Sn_2O_7$ is also obtained. (auth)

16838 MOESSBAUER ABSORBER LINE SEPARATION. Wender, S. A.; Hershkowitz, N. (Univ. of Iowa, Iowa City). Nucl. Instrum. Methods; 98: No. 1, 105-7(1972).

The assumption that Moessbauer spectra from hyperfine split absorbers can be fit by sums of single-line Lorentzians is shown to introduce significant errors in determining the separation of the hyperfine levels. Fits to the separation of two lines are shown to depend on the effective thickness and the linewidths. (auth)

16839 MOESSBAUER SPECTROSCOPY OF ^{119m}Sn EMPLOYING A SOLID STATE DETECTOR. Biran, A. (ELSCINT Ltd., Haifa, Israel); Yarom, A.; Montano, P. A.; Schechter, H.; Shimony, U. Nucl. Instrum. Methods; 98: No. 1, 41-4(1972).

The maximum resonance cross section σ_0 of ^{119m}Sn and the f factors of several absorbers of tin were calculated by means of the Moessbauer effect. A high-resolution silicon lithium-drifted detector was employed to detect the 23.9 keV-Moessbauer γ rays and resolve them from the 25.8-keV x rays of ^{119m}Sn. Thus, a correct background subtraction was possible, and accurate values of 1.328 ± 0.003 × 10^{-18} cm^2 for σ_0, and 0.63 ± 0.02, 0.45 ± 0.02, and 0.050 ± 0.005 for the f factors of $BaSnO_3$, SnO_2 and white tin metal, respectively, were obtained. (auth)

16840 EVIDENCE FOR POSITRONIUM-LIKE STATES IN ALKALI HALIDES. Bisi, A.; Dupasquier, A.; Zappa, L.

(Politecnico, Milan). J. Phys., C (London); 4: No. 15, L311-13(28 Oct 1971).

The influence of a magnetic field on the longer-living component in the time spectra of positrons annihilated in LiF and NaCl was studied. The resulting quenching effect is interpreted as evidence for the formation of a positronium-like system. (auth)

16841 PURELY NUCLEAR DIFFRACTION OF RESONANT GAMMA RAYS DUE TO HYPERFINE QUADRUPOLE INTERACTION. Mirzababaev, R. M.; Smirnov, G. V.; Sklyarevskii, V. V.; (and others) (Inst. of Atomic Energy, Moscow). Phys. Lett.; 37A: No. 5, 441-2(20 Dec 1971).

A purely nuclear diffraction of the resonant 14.4-keV gamma-quanta has been observed from the set of (003) planes of a sodium nitroprusside single crystal. It originates from the quadrupole hyperfine splitting of the ^{57}Fe nuclear levels and different orientations of electric field gradient on these nuclei. (auth)

Theory

Refer also to abstract 16753.

16842 FORBIDDEN BRAGG REFLECTIONS IN NEUTRON AND X-RAY SCATTERING FROM hcp HELIUM. Werthamer, N. R. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Solid State Commun.; 9: No. 24, 2239-40(15 Dec 1971).

The possibility of observing Bragg reflections in the neutron or x-ray diffraction from hcp solid He which would be rigorously forbidden by a structure factor of the usual quasi-harmonic form is investigated. Anharmonic interactions between phonons lead in this noncentrosymmetric structure to phase changes in the Debye–Waller factor, which in turn make visible certain otherwise forbidden reflections. (auth)

PHYSICS (THEORETICAL)

Refer also to abstract 16482.

16843 (JINR–P2-6116) IDENTITY PROBLEM IN QUANTUM MECHANICS. Lyuboshitz, V. L.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The general analysis of the problem of the elementary particle identity in quantum mechanics is given. It is shown that there exists a continuous parameter of the particle similarity; the degree of the inner state nonorthogonality. In the case of the continuous convergence of the particle properties, the behavior of systems consisting of these particles changes continuously without any jumps. (auth)

16844 (JINR–P2-6137) MANY-PARTICLE STATES IN RELATIVISTIC STATISTICAL MECHANICS. Mal'tsev, V. M.; Dushutin, N. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The relativistic statistics of the n-particle system was considered. The limiting cases of thermodynamical behavior of the system were obtained, depending on the transverse particle momentum. (auth)

16845 (NP–19141) ON THE QUANTUM MECHANICAL N-BODY SYSTEM. Schtalheim, Alex (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1970. 101p. Dep. NTIS (U. S. Sales Only).

Thesis.

A quantum-mechanical system of N nonrelativistic particles is considered. The solutions of the Faddeev–Yakubovskii equations below the 4-particle threshold s_4 are discussed. The results are used for a proof of the unitarity of the scattering operator below s_4 and for the definition of scattering cross sections for the 2-n scattering below s_4 and the 3–3 scattering in 3-body systems. (auth)

16846 (NYO–3829-79) MOMENTUM AND ANGULAR MOMENTUM IN RELATIVISTIC CLASSICAL PARTICLE MECHANICS. Jordan, T. F. (Minnesota Univ., Duluth. Dept. of Physics); Shukre, C. S. (Pittsburgh Univ., Pa. Dept. of Physics). Sep 1971. Contract AT(30-1)-3829. 7p. Dep. NTIS.

For a classical-mechanical system of any fixed number of particles it is observed that space-translation invariance and conservation of angular momentum imply conservation of momentum. For three particles it is shown, as previously for two, that Poincaré invariance implies the total kinematic momentum can not be a constant of motion unless the accelerations are zero. The equations involved make it appear most likely that this is true for any number of particles. (auth)

16847 APPROXIMATE SOLUTIONS OF THE LIOUVILLE EQUATION. I. A TRUNCATION SCHEME FOR DISTRIBUTION FUNCTIONS. Gross, Eugene P. (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.); 69: No. 1, 42-55(Jan 1972).

The Liouville equation is studied in the domain of validity of linear response theory. The approach is to assume a functional form for the N-body distribution which fits classes of initial distributions exactly. This determined all time-dependent, reduced distribution functions. In the first approximation, the deviation from the exact equilibrium function is assumed to be one-body additive in phase space for all times. The one-body function is fixed by the first equation of the time-dependent hierarchy. This leads to Zwanzig's modification of the linearized Vlasov equation. In the second approximation, a two-body additive function is included and the first two equations of the hierarchy are used. With the help of exact identities satisfied by the equilibrium correlations one obtains kinetic equations for the singlet and pair distributions in which the potential has been eliminated and only equilibrium correlation functions appear. In the second approximation, the second and fourth frequency moments of the inelastic scattering function are exact. The resulting truncation scheme is meaningful in any order for both strong short-range forces and for plasmas. (auth)

16848 RADIATION OF A CHARGED PARTICLE IN THE PRESENCE OF A SEPARATING BOUNDARY. Pafomov, V. E. Proc. (Tr.) P. N. Lebedev Phys. Inst. (USSR) (Engl. Transl.); 44: 25-157(1971).

The field of a moving charged particle is determined by the image-representation technique for the case in which one boundary between media with different dielectric constants and magnetic susceptibilities is present. The radiation of a particle moving in a ferrodielectric medium ($\epsilon \neq 1$, $\mu \neq 1$) perpendicular to the vacuum–ferrodielectric-medium boundary is then considered; particular attention is paid to the radiation in the frequency range involving negative group velocities, a case which can occur at $\epsilon \neq 1$ and $\mu \neq 1$. Radiation in the presence of one boundary is considered under various specific assumptions on the particle motion. The field of a moving charged particle in the presence of two boundaries is described, and the emission of an oscillator in a thin surface film as well as the radiation of a charged particle moving uniformly and linearly through two boundaries is considered. The radiation field of a charged particle that in some way passes through a layered medium is discussed; the radiation in the optical frequency range is described for the simplest case of uniform linear motion. The radiation is generated in a stack of plates or during the passage of a charged particle through a stack of transparent plates. Next, the radiation of a particle which is once, or multiply, scattered in the medium is treated. Finally, the field of surface waves generated by an arbitrarily moving charged particle at the boundary between vacuum and a nonmagnetic absorbing medium is calculated. All specific considerations assume a radiation field of an arbitrarily moving charged particle in the presence of boundaries, a field which can be directly expressed by the law of the particle motion. (27 figures, 102 references) (R.W.R.)

16849 CHANGE OF VARIABLE FOR THE PERTURBATION PARAMETER IN RAYLEIGH–SCHROEDINGER PERTURBATION THEORY. Amos, A. T. (Univ. of Nottingham, Eng.). Int. J. Quant. Chem.; 6: No. 1, 125-30(Jan 1972).

The Feenberg–Goldhammer change of scale, whereby the H_0 in perturbation theory is replaced by $(1/\mu)H_0$ with μ a scaling parameter, is shown to be equivalent to a change of variable for the perturbation parameter. A more general change of variable is shown to lead to a perturbation series with perturbation energies $E_3, \ldots, E_{2n+1}$ equal to zero. The resulting energy through $(2n+1)$th order has the same form as that found from the Brillouin–Wigner series by different methods. (auth)

16850 GREEN'S FUNCTIONS OF THE SCHROEDINGER EQUATION FOR THE SIMPLEST SYSTEMS. Vetchinkin, S. I.; Bachrach, V. L. (Inst. of Chemical Physics, Moscow). Int. J. Quant. Chem.; 6: No. 1, 143-53(Jan 1972).

The Green's functions for the simplest quantum-mechanical systems (the linear harmonic oscillator, the three-dimensional isotropic oscillator, the Morse oscillator, the Kratser potential, and the double-minimum potential $V_{(x)} = (mw^2/2)(|x| - R)^2$) are presented in closed analytical forms. (auth)

16851 COMPLETE SET OF FUNCTIONS IN THE HEITLER–LONDON METHOD FOR TWO-ELECTRON PROBLEM. Abarenkov, I. V. (Leningrad State Univ.). Int. J. Quant. Chem.; 6: No. 1, 93-100(Jan 1972).

It is shown that under certain restrictions the system of determinants $\psi_i(x_1)\varphi_k(x_2) - \varphi_k(x_1)\psi_i(x_2)$ constructed from two different sets of orbitals ψ_k and φ_k will be the complete set of functions for antisymmetrical two-electron wave functions if the condition $i < k$ is imposed. (auth)

16852 UNIQUENESS THEOREMS FOR THE LINEARIZED BOLTZMANN EQUATION. Case, K. M. (Rockefeller Univ., New York). Phys. Fluids; 15: No. 3, 377-9(Mar 1972).

Two theorems are proved about the solutions of the linearized Boltzmann equation with Maxwell boundary conditions. First, it is shown that the solution of the initial-value problem is unique. Then, it is shown that the solution of the time-independent boundary-value problem is unique up to an additive constant. It can be made completely unique by adding a simple additional condition. The only essential property used in the proofs is the negative semidefinite character of the collision operator. The mathematics used are just the Gauss theorem and Schwarz' inequality. (auth)

16853 WAVES IN PHYSICAL SYSTEMS. Squire, Charles F. Englewood Cliffs, N. J.; Prentice-Hall Inc. (1971). 149p. $8.00.

A small, but very detailed, treatment of wave mechanics in classical and quantum mechanisms is presented. The following chapters are included: (1) oscillating systems, (2) waves on a flexible string, (3) electron waves in a metal, (4) wave propagation in one dimension, (5) waves in two dimensions, (6) plane wave propagation of sound, (7) spherical waves, (8) spherical waves in quantum systems, and (9) elementary wave theory of scattering. (M.O.W.)

16854 STUDY OF ONE-VARIABLE SCHROEDINGER EQUATION GENERATED BY HYPERGEOMETRIC EQUATION.

Natanzon, G. A. Vestn. Leningrad. Univ., No. 10, Fiz., Khim.; No. 2, 22-8(May 1971). (In Russian).

A systematic method of constructing potentials, for which the one-variable Schroedinger equation can be solved in terms of the hypergeometric function, is presented. All the potentials, obtained by energy-independent transformations of the hypergeometric equation, are determined, together with eigenvalues and eigenfunctions. A class of potentials derived from the confluent hypergeometric equation is found by means of a limit process. (auth)

16855 CHERENKOV LOSSES OF A RIGID CYLINDRICAL UNIFORMLY CHARGED BUNCH MOVING IN A HOMOGENEOUS ISOTROPIC MEDIUM. Schnizer, Bernhard (Technische Hochschule, Graz). Acta Phys. Austr.; 32: 154-68(1970).

Integral representations are given for the potential of a circulary cylindrical, uniformly charged, rigid bunch of arbitrary length moving in the direction of its axis with constant speed through a homogeneous, isotropic, dispersive dielectric. The energy loss by Cherenkov radiation is expressed by an integral. This can be evaluated if the frequency dependence of the dielectric constant is neglected. The loss is proportional to the velocity and inversely proportional to the transverse cross section of the bunch and to the dielectric constant; the length of the bunch approaches a shape factor almost monotonously decreasing from unity to $\frac{1}{3}$ with increasing length. (auth)

16856 MOTION OF A CHARGED PARTICLE RESONATING WITH A TRANSVERSE ELECTROMAGNETIC WAVE PROPAGATING ALONG AN AMBIENT NONUNIFORM MAGNETIC FIELD. Kulkarni, V. H.; Das, A. C. (Physical Reserach Lab., Ahmedabad, India). Indian J. Pure Appl. Phys.; 9: No. 8, 590-2(Aug 1971).

From Symposium on ionosphere–magnetosphere interactions; New Delhi, India (Feb 1971).

Equations of motion of a nonrelativistic charged particle, resonating with a circularly polarized electromagnetic wave in the presence of a nonuniform magnetic field, are studied. The solutions show that, in this case, the particle energy perpendicular to the ambient magnetic field increases and shows Fresnel's diffraction pattern-like behavior. The increase in total energy during resonating time is finite. The nonuniformity of the magnetic field seems to have a stabilizing effect on the energy gain of the particle. Further, periodic oscillations of the perpendicular energy of the near-resonant particle for a short period show a burst-like structure, as observed in solar bursts. (auth)

16857 PREDICTION IN QUANTUM PHYSICS. Csonka, Paul L. (Univ. of Oregon, Eugene). Phys. Rev., D; 4: No. 6, 1607-11(15 Sep 1971).

One consequence of dropping the (heretofore unjustified) "reduction postulate" of orthodox quantum mechanics is that even if one measures the values of a complete set of commuting operators belonging to a system at any particular time, one cannot calculate the probability of a state of the system very far in the future or in the past. Quantum cosmology is affected by this. (auth)

16858 UNIFORM ASYMPTOTIC SOLUTION OF THE RADIAL SCHROEDINGER EQUATION FOR AN ELECTRON BOUND IN A CENTRAL FIELD POTENTIAL. Zauderer, Erich (Polytechnic Inst. of Brooklyn). J. Math. Phys. (N. Y.); 13: No. 1, 42-4(Jan 1972).

Assuming Z (the nuclear charge) is large, it is shown, using a theory of McKelvey, how a uniform asymptotic solution of the radial Schroedinger equation for an electron bound in a central field potential and for a related problem may be obtained. Requiring the asymptotic solutions to be bounded leads to a determination of the energy expansion parameters. (auth)

16859 CLASS OF MATRIX ENSEMBLES. Dyson, Freeman J. (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.); 13: No. 1, 90-7(Jan 1972).

A class of random matrix ensembles is defined, with the purpose of providing a realistic statistical description of the Hamiltonian of a complicated quantum-mechanical system (such as a heavy nucleus) for which an approximate model Hamiltonian is known. An ensemble of the class is specified by the model Hamiltonian H_0, an observed eigenvalue distribution-function r(E), and a parameter τ which may be considered to be a fictitious "time." Each of H_0, r(E), and τ may be chosen independently. The ensemble consists of matrices M which are obtained from H_0 by an invariant random Brownian-motion process, lasting for a time τ and tending to pull the eigenvalues of M toward the distribution r(E). For small τ the ensemble allows only small perturbations of H_0. As $\tau \to \infty$, the ensemble tends to a stationary limit independent of H_0 and depending on r(E) alone. The following quantitative results are obtained. (1) It is proved that the global eigenvalue distribution in the limit $\tau \to \infty$ becomes identical with the observed distribution r(E). (2) A nonlinear partial differential equation is obtained for the global eigenvalue distribution $\rho(E,\tau)$ as a function of E and τ. Solution of this equation will show how the distribution changes from the initial form specified by H_0 at $\tau = 0$ to the final form r(E) at $\tau = \infty$. Approximate solution shows that deviations of $\rho(E,\tau)$ from r(E) extending over an interval containing m eigenvalues will disappear exponentially as soon as τ is of the order of mD^2, where D is the local mean level spacing. (3) Exact analytic expressions are obtained for the correlation functions representing the probabilities for finding n eigenvalues at assigned positions $(E_1, \ldots, E_n)$ in the ensemble in the limit $\tau \to \infty$, irrespective of the positions of the remaining (N-n) eigenvalues. It is made plausible, but not proved, that these correlation functions tend to limits as $N \to \infty$, which are universal functions independent of r(E). If proved, this statement would imply that the local statistical properties (spacing distributions, etc.) of eigenvalues in the ensemble become, when τ and N are both large, universal properties independent of the global eigenvalue distributions. In particular, the spacing distributions would be identical with those calculated for more special ensembles by Wigner, Gaudin, and Mehta. (auth)

16860 GENTLE PERTURBATIONS. Radin, Charles (Univ., Nijmegen, Netherlands). Commun. Math. Phys.; 23: No. 3, 189-98(1971).

By introducing a specific type of perturbation, A, in the Hamiltonian, a class of gently perturbed states, $\rho_{\beta,A}$, of a canonical ensemble, ρ_β, is defined. The perturbations are chosen so as to preserve a relation of the form $\rho_{\beta,A} \leq \text{constant} \times \rho_\beta$. Applications in ergodic theory and phase transitions are described. (auth)

16861 QUASI-SPIN SYMMETRIZED ORBITAL OPERATORS FOR d^N CONFIGURATIONS. Wybourne, B. G. (Canterbury Univ., Christchurch, New Zealand). J. Phys. (Paris); 32: No. 4, 259-67 (Apr 1971).

Two-particle orbital operators having well-defined transformation properties under the quasi-spin group and the rotational group R_3 are constructed. The second-order effects produced by electrostatic correlation of one-particle orbital interactions are formally written in terms of the symmetrized operators. The calculation of the matrix elements is discussed, together with its relation to the problem of calculating isoscalar factors. The possible application to electric quadrupole hyperfine interactions is considered. (France)

REACTOR TECHNOLOGY

Power Reactor Development

16862 (ANCR-1016, pp 251-356) REACTOR DEVELOPMENT. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

BONES—plutonium-239 content of, use of neutron-induced fission track autoradiography for detection of, (E)
CRITICAL ASSEMBLIES—reflector for cavity Reactor Critical Experiment, γ heating in beryllium oxide, (E)
CURIUM 244—neutron cross sections from 1 to 500 eV, evaluation of capture, fission, and total, (E/T)
NEUTRON SOURCES—design of portable reactor, for radiography
NEUTRONS—reactions with curium 244 at 1 to 500 eV, capture, fission, and total cross sections for, (E/T)
NEUTRONS, EPITHERMAL—reactions with uranium 235 at 1 to 30 eV, capture, fission, and total cross sections for, (E/T)
—reactions with plutonium 239 at 1 to 45 eV, capture, fission, and total cross sections for, (E/T)
NEUTRONS, THERMAL—reactions with plutonium 242 at 0.00001 to 1 eV, absorption, elastic scattering, and total cross sections for, (T)
PLUTONIUM-239—neutron cross sections from 1 to 45 eV, evaluation of capture, fission, and total, (E/T)
—detection in bone sections, use of neutron-induced fission track autoradiography for, (E)
PLUTONIUM-242—neutron cross sections from 0.00001 to 1 eV, absorption, elastic scattering, and total cross sections for, (T)
—neutron resonance parameters for, evaluation of ENDF/B-III
POWER BURST FACILITY—in-pile loop system for, design and performance of thermal swell accumulator system in
—in-pile loop system for, simulation of flow and pressure control in
REACTOR SAFETY EXPERIMENTS—protection system for LOFT, design and reliability of logic circuitry for
—design parameters for LOFT core I
REACTORS, FAST—physics calculations for, computer codes for processing ENDF/B data for
REACTORS, FLUID FUELED—coolant flow in gas core, simulation of, (E)
—control methods for gas core, reactivity worths of, (E)
REACTORS, RESEARCH—neutron fission rate ratios in CFRMF, fission chamber measurements of
—neutron spectrum in CFRMF, (E)
REACTORS, ROCKET—coolant flow in gas core, simulation of, (E)
—control methods for gas core, reactivity worths of, (E)
TITANIUM—welding to Zircaloy-4, mechanical strength of joints from, (E)
URANIUM-235—neutron cross sections from 1 to 30 eV, evaluation of capture, fission, and total, (E/T)
ZIRCALOY-4—welding to titanium, mechanical strength of joints from, (E) (H.D.R.)

16863 GAS COOLED FAST BREEDER REACTOR DESIGNS. PART 1. THE 300-MW(e) GCFR DEMONSTRATION PLANT. Dee, J. B.; Melese-d'Hospital, G. B. (Gulf General Atomic Co., San Diego, Calif.). Mech. Eng.; 94: No. 1, 18-22(Jan 1972).

Various studies of gas-cooled fast breeder reactor (GCFR) systems with both steam and gas turbine cycles have been performed in Europe and the U. S. Gulf General Atomic designed a 300-MW(e) demonstration plant and performed safety studies for this system. This plant with its indirect steam cycle and safety features is discussed. (auth)

16864 NUCLEAR BREEDING: AN ARGUMENT FOR ALTERNATIVE CONCEPTS. Grenon, Michel; Geist, Jean-Jacques. Power Eng.; 75: No. 12, 42-4(Dec 1971).

A short historical analysis of breeder reactor development is presented in which the fast sodium-cooled reactor is seen to be the choice in all countries. The wisdom of concentrating on only one breeder type is discussed, and some of the logical alternative reactor types are examined. (H.D.R.)

16865 SUMMARY: ENERGY POLICY ISSUES FOR THE UNITED STATES DURING THE SEVENTIES. Armstrong, Ellis L. (Dept. of the Interior, Washington, D. C.). Combustion; 43: No. 6, 38-43(Dec 1971).

A report on the many aspects of energy policy in the U. S. is summarized. The report examines the interrelationships of the fragmented and competing industries serving the energy market and the similarly fragmented government policies involved in energy production and marketing. (H.D.R.)

16866 PODSTAWOWE PROBLEMY ENERGETYKI. Materialy Sympozjum Energetyka Jadrowa, Jablonna, Poland, 19–20 Czerwca 1970. (Basic Problems of Power Engineering. Materials of a Symposium Relating to Nuclear Energy, Jablonna, Poland, June 19–20, 1970). Warsaw; Drukuje Osrodek Informacji o Energii Jadrowej (1971). 224p. (CONF-700661).

The problems examined include a forecast of the development of nuclear power generation in Poland, fuel cycle economics, experimental measurements and calculations of the thermodynamic reactor parameters, automatic control problems, shielding against ionizing radiations, and basic design of heat exchangers in nuclear power plants. (TTT)

16867 FORECASTS OF ITALY'S ENERGY REQUIREMENTS UP TO THE YEAR 1990 AND ROLE OF NUCLEAR ENERGY. Angelini, A. M. (ENEL, Rome); Marinone, F. Energ. Nucl. (Milan); 18: No. 11, 579-87(Nov 1971).

The first part of the paper analyzes the growth of demand related to the individual sources of energy in Italy in the past fifteen years and points out the main problems associated with the energy situation in the country, particularly as concerns reliability and economy of fuel procurement. Based on this analysis and on the anticipated development of Italy's economy, predictions of the energy demand up to the year 1990 are made and a brief discussion follows on the contribution that each primary source will be able to make to cover the demand, in the light of the domestic energy resources, the foreseeable trend of the world fuel market and the anticipated technical and economic evolution of the processes applied for the transformation and utilization of the sources. The second part of the paper reviews the past history of the Italian electric power system and predicts its future evolution within the framework of the country's energy situation. After a brief description of the main features of the system, the electric energy and power requirements are predicted up to the year 1990. The potential for development of hydroelectric, geothermal and pumped-storage stations is considered, as well as the role that nuclear energy may be called upon to play in order to meet the increased requirements. An analysis is made of the various factors that may affect such a role—technical and financial factors, environment protection, dependable sources of supply etc—for the prediction of the development of nuclear stations in Italy over the same period. It appears that nuclear energy will assume growing importance in the coverage of the demand of electricity. (auth)

16868 CIRENE PROJECT. Silvestri, M. (CISE, Milan); Casagrande, I.; Broggiato, A.; Mancini, C.; Pedretti, A. Energ. Nucl. (Milan); 18: No. 11, 597-606(Nov 1971).

The CIRENE nuclear reactor concept developed in Italy is described. This is a cold heavy water moderated, boiling light water cooled, natural uranium fuelled (with or without plutonium cycle), pressure tube reactor. After mentioning reasons why it was found suitable to develop a reactor based on the use of natural uranium, data and characteristics are given which make CIRENE a possible line of development for D_2O advanced converters. It is in particular pointed out that along with some favorable characteristics of the CIRENE reactor over the CANDUPHW (pressurized D_2O moderated and cooled) there are the advantages deriving from CIRENE similarity with CANDU-PHW from the technological point of view. The design aspects are summarized of the demonstrative 40 MW(e) CIRENE prototype. The research and development work developed in support to the design work is briefly accounted for. (auth)

16869 INDUSTRIAL ASPECTS OF FAST BREEDER REACTOR. Crette, J. P. (Groupement Atomique Alsacienne Atlantique, Hauts-de-Seine, France). Kerntech. Atomprax.; 13: No. 11, 491-5(Nov 1971).

Fast breeder reactor development in France is briefly reviewed. The design features of the Phenix demonstration reactor are described. (H.D.R.)

16870 NUCLEAR REACTOR. (to Atomic Energy of Canada Ltd.). British Patent 1,257,421. 15 Dec 1971. Priority date 21 Apr 1969, United States.

REACTORS, HEAVY WATER—design of cavity-core pebble bed type
REACTORS, PEBBLE BED—design of heavy water moderated and reflected, (H.D.R.)

Physics and Core Engineering

Refer also to abstracts 15254 and 17107.

16871 (AED-CONF-71-100-10) ASSESSMENT WORK ON THE GAS COOLED FAST BREEDER REACTOR IN THE FEDERAL REPUBLIC OF GERMANY. Dalle Donne, M.; Wirtz, K. (Kernforschungszentrum, Karlsruhe (West Germany)); Kraemer, H. (Kernforschungsanlage, Juelich (West Germany)). May 1971. 8p. (CONF-710901-518). Dep. NTIS (U. S. Sales Only).

From fourth international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

Conceptual studies in the Federal Republic of Germany are presented for the gas-cooled fast breeder reactor. Physics calculations, component development, and economic aspects are analyzed. 29 references. (D.C.C.)

16872 (CEA-CONF-1870) SEVERAL MECHANICAL PROBLEMS POSED BY THE VESSEL AND NEIGHBORING STRUCTURE IN REACTORS WITH TUBES OF FORCE. Roche, R.; Vrillon, B. ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]). [1971]. 31p. (In French). (CONF-710903-7). Dep. NTIS (U. S. Sales Only).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971).

The finite element method was found to be impractical for computing the stresses and deformations occurring in the vessel base and calandria tubes; in consequence analytical methods based on the plate theory were used, a (SEMT 0589) program based on the general theory of the bending and shearing of plates on elastic foundations being used. A series of models was used to simulate accident conditions. The studies concerned the probability of pressure tube failure. In connection with the design of a 600 MW reactor, a large experimental program to solve the technological problems concerning the behavior of the various components is envisaged. Problems involved in the construction of the structures connecting the plates and the tubular cross members at the base of the vessel are of particular interest. 12 references. (France)

16873 (JAERI-1199(Suppl.1)) JAERI FAST REACTOR GROUP CONSTANTS. Supplement No. 1. Katsuragi, Satoru; Takano, Hideki; Nakagawa, Masayuki; Hasegawa, Akira (Japan Atomic Energy Research Inst., Tokyo). Nov 1971. 11p. Dep. NTIS (U. S. Sales Only).

A revision has been made for the JAERI Fast Set by taking results of benchmark analyses and recent evaluation of nuclear data. The revision is performed for the important nuclei, ^{238}U, ^{235}U, and ^{240}Pu. Furthermore, the group constants of ^{241}Pu for the resonance energy region are produced. 15 references. (auth)

16874 (WCAP-7836) INLET ORIFICING OF OPEN PWR CORES. Carter, F. D. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1972. 45p.

Inlet orificing in an open PWR core was studied using detailed experimental and analytical tools. Withholding flow from cool fuel assemblies and adding flow to warm fuel assemblies at the core inlet is effective because flow only redistributes gradually in open cores. The net effect is a higher mass flow rate and a lower enthalpy in the hot channel. One orificing scheme studied in detail resulted in a one percent increase in core power capability for the same minimum DNB ratio. It was evident that this basic orificing technique could be used for even larger power capability increases. (auth)

16875 (WCAP-7838) APPLICATION OF THE THINC PROGRAM TO PWR DESIGN. Shefcheck, J. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1972. 41p.

Thermal and hydraulic analyses on PWR open lattice cores are made, utilizing the THINC digital computer program. The procedure for the application of the THINC program to design evaluations is presented. Experimental justification is given for methods or analytical models incorporated into the THINC program which pertain to inlet velocity distributions, crossflow between assemblies and coolant mixing. The geometrical representation of the core for design analyses is illustrated. Sensitivity of THINC results to various input parameters is also discussed to provide better understanding of the design procedure. A comparison is presented of the hot channel enthalpy rise and DNB ratio evaluations between the THINC analyses and previous design methods. (auth)

16876 NUCLEAR REACTOR CORE CLAMPING SYSTEM. Guenther, Ralph W.; Hansen, Ned P. (to General Electric Co.). U. S. Patent 3,627,634. 14 Dec 1971. Filed 26 Nov 1968.

A system for tightly clamping together the core components of a nuclear reactor is disclosed. A typical core is made up of a plurality of subassemblies each contained in an elongated shroud having a hexagonal cross section. Each of the outer ring of subassemblies includes ram means adapted to be pushed outwardly against a fixed ring which surrounds the core. This causes this outer ring, or edge plate of subassemblies to press inwardly on the core, tightly clamping the overall assembly together, preventing shifting during reactor operation and the resulting undesirable reactivity changes. (auth)

16877 HEAT TRANSFER AND FLUID FLOW STUDIES FOR THE DEVELOPMENT OF A NUCLEAR REACTOR: THE EXAMPLE OF CIRENE AND THE POSSIBLE CONNECTIONS WITH OTHER INDUSTRIAL PROBLEMS. Cerrai, E.; Hassid, A. (Centro Informazioni Studi Esperienze, Milan). Energ. Nucl. (Milan); 18: No. 4, 228-39(1971). (In Italian). (CONF-710317-4).

From sixteenth nuclear congress; Rome, Italy (25 Mar 1971).

The origin and development of the heat transfer and fluid flow studies carried out by CISE in the 60's in support of the R & D program for the CIRENE reactor are described. The problems which have been analyzed in the various phases of this work are reviewed. (INIS)

16878 INFLUENCE OF A LIQUID METAL FAST BREEDER REACTOR ENVIRONMENT ON INCIPIENT BOILING SUPERHEAT. Holtz, Robert E. (Argonne National Lab., Ill.); Fauske, Hans K.; Eggen, Donald T. Nucl. Sci. Eng.; 47: No. 2, 225-8 (Feb 1972).

An analytical investigation is presented of the influence of a fast reactor environment on the incipient boiling superheat of the sodium coolant. Calculated results show that for the size range of surface cavities expected in LMFBR systems, the influence of the reactor environment on incipient superheat should be quite small. (auth)

16879 USE OF STATISTICAL THEORY OF EXTREMES IN HOT CHANNEL ANALYSIS OF A LIQUID METAL FAST BREEDER REACTOR. Mazumdar, M. (Westinghouse Research Labs., Pittsburgh). Nucl. Sci. Eng.; 47: No. 2, 187-94(Feb 1972).

In the thermal hydraulic design of nuclear reactor cores, it is of interest to know the probability for 0, 1, 2, . . . , D hot channels and/or cladding and fuel hot spots [i.e., channels (spots) in the core at which temperature limits are exceeded]. A special case, that of zero hot channels, is considered and it is shown that by application of the theory of extremes numerical results can still be obtained without the use of Monte Carlo computations. A hot channel factor analysis is carried out using the proposed method on a simplified hypothetical LMFBR-type core and the results are compared with those obtained from the method of correlated temperatures and Amendola's method. The method based on extreme value theory compares very favorably with the more general method of correlated temperatures. (auth)

Control and Instrumentation

Refer also to abstract 15116.

16880 (WCAP-7817(Suppl.2)) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (LOW SEISMIC PLANTS). Potochnik, L. M. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 42p.

Seismic testing of electrical and control equipment over the range of 1 Hz to 5 Hz is described. To demonstrate the ability of the equipment to perform under such earthquake disturbances, it was subjected to vibration tests which simulated the seismic conditions for the "low seismic" class of plants. The "low seismic" test level is anticipated to qualify instrumentation and control equipment for any plant with a Design Basis Earthquake horizontal ground acceleration not exceeding 0.2 g. During testing, the equipment was operated and the critical functions monitored to verify proper performance. The results show that there were no electrical irregularities that would leave the plant in an unsafe condition even though trips were initiated. (auth)

16881 (WCAP-7817(Suppl.3)) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (W SOLID STATE PROTECTION SYSTEM) (LOW SEISMIC PLANTS). Vogeding, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 10p.

The Westinghouse solid state protection system equipment, which is associated with a reactor trip and/or safeguards actuation, was tested under simulated seismic conditions (covering the "low seismic" class of plants) to ensure that this equipment is capable of performing its function both during and after the earthquake. The equipment tested is representative of the reactor protection system equipment that is installed in the "low seismic" class of plants. The test results show that the electrical functions of the Westinghouse solid state protection system equipment were maintained both during and after the simulated seismic condition. (auth)

16882 (WCAP-7821) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (HIGH SEISMIC PLANTS). Potochnik, L. M. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 49p.

In a nuclear power plant, electrical and control equipment which initiates reactor trips, actuates safeguards systems, and/or monitors radioactive releases from the plant must be capable of performing its functions during and after an earthquake that has occurred at the plant site. To demonstrate the ability of this equipment to perform under earthquake conditions, selected types of this essential equipment, representative of all protection and safeguards circuits and equipment, were subjected to vibration tests which simulated the seismic conditions for the "high seismic" class of plants. "High seismic" plants are those in which the Design Basis Earthquake (DBE) maximum horizontal floor accelerations, for floors on which this equipment is located, is in the range of 0.2 g to 0.4 g. During testing, the equipment was operated and critical functions monitored to verify their proper performance. The results show that there were no electrical irregularities that would leave the plant in an unsafe condition even though trips were initiated. (auth)

16883 (WCAP-7821(Suppl.1)) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (HIGH SEISMIC PLANTS). Potochnik, L. M. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 17p.

Seismic testing performed in WCID Process Control Equipment and Westinghouse Solid State Protection System over the range of 5 Hz to 25 Hz is described. To demonstrate its ability to perform under earthquake disturbances, the equipment was subjected to vibration tests which simulated the seismic conditions for the "high seismic" class of plants. "High seismic" plants are those in which the Design Basis Earthquake (DBE) maximum horizontal floor accelerations, for floors on which this equipment is located, is in the range of 0.2 g to 0.4 g. During testing, the equipment was operated and critical functions monitored to verify their proper performance. The results show that there were no electrical irregularities that would leave the plant in an unsafe condition even though trips were initiated. (auth)

16884 (WCAP-7821(Suppl.2)) SEISMIC TESTING OF ELECTRICAL AND CONTROL EQUIPMENT (HIGH SEISMIC PLANTS). Potochnik, L. M. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 40p.

Seismic testing of electrical and control equipment over the range of 1 HZ to 5 HZ is described. To demonstrate the ability of the equipment to perform under such earthquake disturbances, it was subjected to vibration tests which simulated the seismic conditions for the "high seismic" class of plants. "High seismic" plants are those in which the Design Basis Earthquake (DBE) maximum horizontal floor accelerations, for floors on which this equipment is located, is in the range of 0.2 g to 0.4 g. During testing, the equipment was operated and critical functions monitored to verify their proper performance. The results show that there were no electrical irregularities that would leave the plant in an unsafe condition even though trips were initiated. (auth)

16885 COMPUTER CONTROL SYSTEM FOR NUCLEAR POWER PLANT. Kogami, Mineichi (Tokyo Shibaura Electric Co., Ltd., Fuchu, Japan). Denki Keisan; 38: No. 15, 239-45(Dec 1970). (In Japanese).

The functions of computer control systems for BWR type power plants are as follows. (1) Alarm logging, (2) event recall and sequence annunciation, recording of input data in case of unusual event, (3) calculation of in-core heat output distribution, maximum fractional limited power density, and minimum critical heat flux ratio, (4) in-core heat output monitoring, (5) rod position information, (6) rod worth minimizing (7) summation of neutron flux radiation and calculation of isotope composition of fuel, and (8) hourly, daily and monthly calculation of flux, thermal efficiency, and electric power of turbine generator system. The computer control system for PWR power plants has similar functions to those of BWR systems except for the calculation of DNB (departure from nucleate boiling) and prediction of xenon density and iodine density in the core. At AGR power plants in England, dualization of instrumentation and back-up computers are adopted to improve reliability of the system. The computers play roles of (1) CRT display of plant data, (2) alarm display, (3) analysis of the cause of abnormal events and indication to operators, (4) control of sector control rods and measuring temperature of cooling gas, and so on. It has become more necessary to use the computers in nuclear power plants not only for data processing, but for direct control. To achieve this, the reliability of computer systems must be improved, and optimization of overall systems must be studied based on precise analysis of the plant. (Japan)

Containment Systems, Waste Processing, and Radiation Protection

Refer also to abstract 15041.

16886 PWR CONTAINMENT STRUCTURES DESIGN EXPERIENCE. Haga, P. Blair; Stevenson, John D. (Westinghouse Pressurized Water Reactor Systems Div., Pittsburgh). J. Power Div., Amer. Soc. Civil Eng.; 96: No. PO1, 145-55 (Jan 1970).

The nuclear power industry has come of age within the past few years. There are over 70 power reactors under construction or currently planned in the United States. A large majority of these power reactors employ either reinforced or prestressed concrete containment structures. Some of the techniques and parameters associated with the design of four of these structures are presented. 7 references. (auth)

16887 TEST STANDARDS FOR NUCLEAR PLANT MOTORS. Nailen, R. L. Power Eng.; 75: No. 12, 39-41(Dec 1971).

The proposed guide for testing Class 1 motors is discussed. Class 1 motors include induction motors inside the reactor containment which drive fans and pumps in the event of a reactor malfunction. The difficulties involved in deriving standards to meet the requirements of motor reliability are described. (H.D.R.)

Coolant System

16888 IN-SERVICE ACOUSTIC EMISSION MONITORING OF REACTOR PRESSURE VESSELS. Vetrano, J. B.; Jolly, W. D. (Battelle Memorial Inst., Richland, Wash.). Mater. Eval.; 30: No. 1, 9-12(Jan 1972).

It is generally recognized that periodic nondestructive evaluation of nuclear reactor pressure vessels is a necessity. These inspections will be performed while the reactor is shut down for refueling. It is also generally recognized that it would be desirable to continuously monitor the nuclear reactor pressure vessel for flaw growth during operation. A research program directed toward the development of an acoustic emission system for continuous surveillance of reactors is summarized. The program results indicate that it will be feasible to detect and locate growing subcritical flaws in operating reactor pressure vessels. (auth)

16889 SEALING ELEMENT FOR ASSEMBLY PARTS SUBJECTED TO TEMPERATURE FLUCTUATIONS. (to L and C Steinmuller GmbH). British Patent 1,256,917. 15 Dec 1971. Priority date 9 Feb 1968, Germany.

BOILERS—tubes for gas cooled, sealing means for concentric
REACTORS, GAS COOLED—steam generators for, sealing means for concentric tubes in
SEALS AND GLANDS—design of heat by changer cencentric tube, (H.D.R.)

16890 ADVANCED GAS COOLED REACTORS WITH THE BOILERS IN THE WALL OF THE PRESTRESSED CONCRETE PRESSURE VESSEL. Kley, H. Brown Boveri Nachr.; 52: 223-7(Jul 1970). (In German).

The installation of the boilers in the wall of the pressure vessel has led to a much more compact design, simpler construction and consequently reduced construction time. Because of the high efficiency of the AGR it requires no more cooling water than an equivalent conventional power station. The design of the boiler, pressure vessel, reactor core and fuel change machine are described. (UKAEA Info. Bull.)

16891 JET PUMP IN A BOILING WATER-TYPE NUCLEAR REACTOR. Gluntz, Douglas M.; Moen, Robert H. (to General Electric Co.). U. S. Patent 3,625,820. 7 Dec 1971. Filed 14 Jun 1968.

An improved jet pump for a nuclear reactor is disclosed. A combination of novel nozzle, mixer and diffuser configurations give a jet pump of uniquely high efficiency. This jet pump is especially useful in circulating cooling water through a boiling water-type nuclear reactor. (auth)

Fuels and Fuel Elements

Refer also to abstract 15651.

16892 (ANL-7849) INTERACTION OF STAINLESS STEEL SURFACES WITH HIGH-TEMPERATURE SODIUM. EBR-II Project. Ruther, W. E.; Kimont, E. L.; Claar, T. D.; Wang, J. Y. N. (Argonne National Lab., Ill.). Oct 1971. Contract W-31-109-eng-38. 22p. Dep. NTIS.

Several experiments contradict the hypothesis postulating the deep grain-boundary penetration of structurally sound Type 304 stainless steel by high-temperature sodium. The rapid disintegration in subsequent Strauss testing reported by earlier investigators has taken place only with specimens exposed to the so-

dium in their test equipment and with those samples deliberately carburized during other sodium exposures. Chemical analyses of the surface layers of specimens exposed in their equipment confirmed the presence of increased carbon. In the absence of a carburizing source, specimens exposed to sodium behaved equivalently in Strauss testing to those exposed in vacuum to the same heat treatment. No detectable amount of sodium diffused through a thin-walled capsule at 650°C. No significant grain-boundary attack on Types 304, 304L, 316, and 316L stainless steels was noted in experiments lasting 1 year at 650°C. These experiments included three intermediate washings and inspections of the specimens. Microimperfections in ordinary surfaces have retained sodium or sodium compounds after washing, but electropolished surfaces did not. The deep penetration of sodium along sulfide and oxide inclusion-stringers in austenitic stainless steel has been demonstrated. (23 references) (auth)

16893 (EUR–4693) TRANSPORT OF FUEL BALLS BY MEANS OF GRAVITY AND PNEUMATICS IN THE FUEL ELEMENT CIRCULATING SYSTEM OF PEBBLE BED REACTOR, ESPECIALLY MOVEMENT OF SINGLE FUEL BALLS IN PIPES. Rysy, W. (European Atomic Energy Community. Brown Boveri/Krupp Reaktorbau G.m.b.H., Cologne (West Germany)). 1971. 100p. (In German). Dep. NTIS (U. S. Sales Only). EUR DM 11.–.

The design of the fuel element circulating system of the THTR pebble bed reactor is described in order to demonstrate the subsequent mathematical treatment of the sphere movement in tubes. Since the gas velocity for suspension is important and fundamental for the pneumatic transport, a theoretical equation is derived by means of the theorem of momentum for the gas velocity for suspension of spheres in a tube. It is valid for inclined as well as for vertical tubes and represents very well the experimental results. Graphs of these gas velocities and of the drag coefficients of spheres in a tube are presented. From Newton's laws of motion theoretical equations are formed giving the time variation of the sphere velocity and of the rolling distance covered by the sphere in a sloping tube with gas flow. A comparison with some experimental results at a tube diameter of 65 mm and sphere diameters from 58 to 62 mm shows that the experimental values are well represented by the theory in a wide range of gas velocities. In addition, several critical cases are investigated. An equation for the momentum of inertia of an inhomogeneous sphere is derived. 114 references. (auth)

16894 (NP–19145) MOLTEN SALT BREEDER REACTOR CONCEPT. Quarterly Report for the Period Ending July 31, 1971. (Atomic Energy Commission, Bombay (India)). 8p. Dep. NTIS (U. S. Sales Only).

The solubility of PuF_3 in $LiF-BeF_2-ThF_4$ mixtures of composition 71.6-16.2-12.2 m/o has been determined in the temperature range of 523 to 758°C and the values have been found to vary between 0.77 m/o at 523°C to 3.79 m/o at 758°C. The experiment confirms the trend in the solubility values previously reported. These values are sufficiently high for fuelling a molten salt reactor using PuF_3 as fuel. 10 references. (auth)

16895 (ORNL–4710) FINAL REPORT ON THE SECOND FUEL ROD FAILURE TRANSIENT TEST OF A ZIRCALOY-CLAD FUEL ROD CLUSTER IN TREAT. Lorenz, R. A.; Parker, G. W. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 57p. Dep. NTIS.

The second fuel rod failure experiment in the Transient Reactor Test Facility (TREAT) was performed with a seven-rod bundle of 27-in.-long, Zircaloy-clad UO_2 fuel rods in a flowing steam atmosphere. A water-reactor loss-of-coolant accident was simulated by operating the TREAT reactor at constant power for 30 sec so that fission heat in the UO_2 pellets caused the Zircaloy cladding temperature to rise 80°F/sec to a maximum of approximately 2400°F. The fuel rods were initially pressurized with helium to between 65 and 75 psia (77°F) to simulate accumulated fission gas. The Zircaloy cladding swelled and ruptured. The amount and distribution of swelling could result in the blockage of 91% of the bundle coolant channel area of a Boiling Water Reactor (BWR) at the location of maximum swelling. The average rod maximum circumferential swelling was 60%. Metallographic examination revealed ductile ruptures and significant oxygen pickup. Zirconium-steam reaction was 1.1%. The center rod was preirradiated to 2800 MWd/MT in the Materials Testing Reactor (MTR) and Engineering Test Reactor (ETR) to build up an inventory of fission products and to determine irradiation effects on fuel rod failure characteristics. No irradiation effect was seen on the swelling and rupture characteristics from this low-level irradiation. The release of gaseous fission-product ^{85}Kr from the irradiated center rod was approximately 0.5%. The release of volatile fission products ^{129}I, ^{131}I, and ^{137}Cs was slightly lower. Approximately 2.5% of the ^{131}I released from the center rod was in a chemically unreactive form, probably CH_3I. (35 references) (auth)

16896 (ORNL–4711) CALCULATED CRITICALITY DATA FOR LMFBR $(U,Pu)O_2$–WATER SYSTEMS. Cobb, W. R. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 97p. Dep. NTIS.

Calculated criticality data are presented for typical LMFBR mixed-oxide fuel-water systems based on the weight fraction of PuO_2, the degree of heterogeneity of the fuel, and the degree of moderation as variables within the ranges of interest to LMFBR fuel-processing criticality safety. Limited data are also presented to indicate the poisoning effects of nitrate, boron, and stainless steel. The calculational methods employed are discussed, including an improved strategy for critical-dimension searches developed, as well as the results and the expected accuracy of the data. Tables of buckling, extrapolation distances, critical dimensions, and masses are presented. (14 references) (auth)

16897 (ORNL-TM–3630) COMPUTER SIMULATION OF ELECTRICALLY HEATED DUMMY FUEL ELEMENTS FOR THE FFM: THERMAL EFFECTS OF PIN DEFECTS. Fukuda, A.; Parsly, L. F. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 18p. Dep. NTIS.

Methods of computer simulation of acceptance tests for electric heaters to be used as fuel rod simulators in the LMFBR Fuel Failure Mockup are described. The tests include brief transient operation at 50 to 75% of rated power in air and steady-state operation in air at very low power. The heater surface temperature is observed, and irregularities in the temperature are presumed to indicate internal defects. Computer programs for calculating heat conduction were used to make predictions of the surface temperature of heaters containing various postulated defects, including regions of low thermal conductivity, low density of boron nitride insulation, and varying heat release rates. Comparisons of the predictions and test results were helpful in interpreting the results. The results of the calculations are summarized. (auth)

16898 (ORNL-TM–3641) RADIATION PROPERTIES OF SPENT PLUTONIUM FUELS. Bell, M. J. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 31p. (CONF-711009–12). Dep. NTIS.

From Joint meeting of the American Nuclear Society; Miami Beach, Fla. (17 Oct 1971).

The ORIGEN computer code has been used to compute the time-dependent thermal power, photon spectrum, and neutron production rate resulting from fast- and thermal-neutron-induced fission of ^{235}U and ^{239}Pu fuels. Computed afterheats and photon spectra for thermal fission of ^{235}U are shown to be in good agreement with published data, and computed radioactivities and thermal power of plutonium irradiated to low exposures in both thermal- and fast-neutron spectra are shown to agree well with experimentally measured properties. Predictions are made of afterheat and penetrating radiation production rates for plutonium fuels irradiated to high exposures typical of oxide-type LMFBRs. (20 references) (auth)

16899 (RD/B/N–2119) FISPA: AN AUTOMATED VERSION OF THE FISP PROGRAM FOR OPERATIONAL HEALTH PHYSICS APPLICATIONS. Beynon, S. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1971. 13p. Dep. NTIS (U. S. Sales Only).

A shortened version of the FISP program was developed for the specific purpose of calculating activities of four isotopes, ^{90}Sr, ^{106}Ru, ^{131}I and ^{137}Cs, within irradiated fuel. Total beta heating within and 12 group gamma spectra from the irradiated fuel are also available. A library of Magnox and AGR data was incorporated so that users only specify burnup, rating, cooling time, and (for AGR only), enrichment and weight of fuel element. The program can be expanded further to include data for future station types, and is specially designed to be of interest to those involved in Operational Health Physics problems. (auth) (UK)

16900 NUCLEAR FUEL ASSEMBLY. Venier, Dominic Ambrose; Smith, Bart Alan; Lass, James Lloyd (to General Electric Co.). British Patent 1,256,656. 15 Dec 1971. Priority date 15 Aug 1969, United States.

REACTOR FUEL ELEMENTS— coolant flow in assemblies of, control of bypass
REACTORS, BOILING— fuel assemblies for, control of bypass coolant flow in (H.D.R.)

16901 FAST NEUTRON REACTOR FUEL CYCLE. Guillet, H. (Cadarache Nuclear Research Centre, France); Michel, P.;

Rougeau, J. P. Kerntech. Atomprax.; 13: No. 11, 481-3(Nov 1971).

The fuel cycle of fast reactors has several original aspects which have involved a special research and development effort now directed to suit the demands of industrial production. Fuel element fabrication, treatment of irradiated fuel, and economic problems are discussed. It is estimated that the fuel costs will amount to between one-third and one-half of the costs of light-water reactor fuel. (auth)

16902 ATTACHMENT MEANS FOR THE SUPERSTRUCTURE ABOVE THE CORE IN A LIGHT WATER BOILING REACTOR. Sodergard, Bengt Martin (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,625,819. 7 Dec 1971. Priority date 14 Feb 1967, Sweden.

In a light water boiling reactor, a superstructure comprising a steam treating unit and a lid for the moderator tank is arranged above the moderator tank and is detachable for the purpose of interchange of fuel. A shield substantially concentric with the moderator tank and having a greater diameter is attached to the tank in such a position that the upper end of the shield is at a level above the lid of the tank. The superstructure is fixed to the upper part of the shield by a detachable hook joint which transmits compressive force against the lid to force it against the top of the tank through rodlike supporting members. (auth)

16903 NUCLEAR REACTOR IN WHICH THE COOLANT IS BOILING LIGHT WATER. Margen, Peter Heinrich Erwin (to Aktiebolaget Atomenergi). U. S. Patent 3,619,364. 9 Nov 1971. Priority date 12 Apr 1967, Sweden.

In a nuclear reactor of the boiling light water type the steam-water mixture produced in the fuel cartridges is passed through steam-water separators in which the steam is separated from the water. According to an improved embodiment a fuel cartridge is united with a steam-water separator to form a unit. The unit can be lifted by a refueling machine, so as to be inserted into and removed from the reactor through a refueling tube. (auth)

16904 DESIGN OF FUEL CANS OF MINIMAL WALL THICKNESS USED IN STEAM-COOLED FAST BREEDER REACTORS. Eisner, J. H. (Sandvik-Universal Tube, GmbH, Hessen, Ger.). Konstr. Masch.-, App.-Geraetebau; 23: No. 6, 217-22(1971). (In German).

A description is given of the design criteria of collapsed cans i.e., cans which are not stable against the outer pressure but collapse onto the containing fuel and rest upon it. The reciprocal strain of fuel and can in dependence of the power and the power cycle is investigated theoretically and demonstrated by calculating examples. It is shown that it is possible to achieve a life of more than 10,000 hr using collapsed cans with a wall thickness of only 0.3 mm. (INIS)

16905 REQUIREMENTS FOR MANUFACTURE OF NUCLEAR FUEL IN AUSTRALIA. Alder, K. F. (Australian Atomic Energy Commission, Lucas Heights); Wright, W. J. Australas. Inst. Mining Met. Proc.; No. 240, 75-82(Dec 1971).

Nuclear power stations to be installed in Australia will be fuelled from Australian resources of raw materials. This will require the establishment of new manufacturing industries and the eventual expansion of established activities, especially in uranium mining and the preparation of precision metal products. Some predictions of the possible growth of nuclear power installations in Australia are presented. These might amount to 4,000 MW(e) by 1985 and 11,500 MW(e) by 1990 and towards the end of the century, about 50% of new generating plants might be nuclear. Predictions are given of the demands for materials (uranium and zirconium) and fuel manufacturing services for four reactor systems which might be considered in the program. The availability of raw materials and technical capability place Australia in a particularly good position to undertake the manufacture of nuclear fuel. (auth)

Auxiliary Systems and Engineered Safeguards

16906 (JPRS-54787) RELEASE VALVE FOR PROTECTING HERMETICALLY SEALED AREAS OF ATOMIC POWER STATIONS. Mal'tsev, B. K.; Rzheznikov, Yu. V.; Puzyrev, L. N.; Gryzlov, A. G. Translated from Teploenergetika; No. 8, 62-5 (1971). 7p. NTIS.

The design characteristics of a pressure actuated safety valve are presented. The valve releases pressure during transient conditions following a break in the primary cooling system piping for water cooled reactors. (D.C.C.)

16907 (WCAP-7744(Vol.2)) ENVIRONMENTAL TESTING OF ENGINEERED SAFETY FEATURES RELATED EQUIPMENT (NSSS-NONSTANDARD SCOPE). Locante, J.; Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa.). Sep 1970. 59p.

A program was undertaken in order to insure the continued operability of the safety related equipment in the post accident environments of temperature, pressure, chemistry, and radiation. The objectives of this program were met by measuring the performance or characteristics of the safety related equipment during or after exposure to the anticipated post accident containment conditions. The overall test program was divided into subprograms categorized by equipment functional requirements. The subprograms described include: (1) Reactor Containment Fan Cooler Motor Insulation and Lubrication Irradiation; (2) Post Accident Hydrogen Combustion System; (3) Electrical Cables and Splices. The results of the overall test program indicate that the safeguards equipment will operate satisfactorily during and following exposure to the containment post accident environments of temperature, pressure, chemistry, and radiation. Presented are discussions of the testing performed and results obtained in each of the subprograms as well as a section on the post accident containment conditions selected for the environmental testing program. (auth)

16908 APPLICATION OF BAYESIAN DECISION THEORY TO THE SELECTION OF FUNCTIONAL TEST INTERVALS FOR ENGINEERED SAFETY SYSTEMS. Buoni, Frederick Buell. Columbus, Ohio; Ohio State Univ. (1971). 179p. University Microfilms Order No. 71-27,440.

Thesis.

The effectiveness of Engineered Safety Systems (ESS) is increasing in importance for the safety assessment of nuclear power plants as these plants grow in number and size. The assessment of reliability of the ESS is one measure of the safety of the plant. The performance of functional tests is required by the USAEC to verify the operability of ESS. The effect of a functional testing program upon the reliability assessment of one type of ESS is analyzed using Bayesian decision theory to determine the effect of information upon a decision process. This type of analysis explicitly considers uncertainties in the reliability model of the ESS and expresses their effects for evaluation by the decision maker. The uncertainties considered are the type of failure model applicable and the value of the failure or hazard rate. (Diss. Abstr. Int., B)

16909 RECENT REACTORS FOR ATOMIC POWER GENERATION AND PROTECTION EQUIPMENT. Sato, Takaya (Kansai Electric Power Co., Inc., Osaka). Denki Keisan; 39: No. 5, 139-46(May 1971). (In Japanese).

General block diagrams, components, functions and control of PWR and BWR plants are described. Protection equipment for nuclear reactors is described. As the reactor protection equipment, there are two kinds, namely those for preventing occurrence and extension of accidents beforehand and those countermeasures against large accidents, such as emergency core cooling equipment and reactor containment. As an example of the former equipment, reactor scram equipment is described. The scram circuits must have characteristics of "fail safe," and they are formed in "2 out of 3 circuits" type. Radiation protection in nuclear power plants is described. The radiation protection is performed by two methods, installation of equipment for the radiation protection and radiation control in nuclear power plants. The protection equipment involves shielding against external exposure, ventilation facilities against internal exposure, and equipment of management and disposition of radioactive wastes (vapor, liquid, and solid). The radiation control consists of three parts: environmental control, personnel control, and work control. (Japan)

Operation and Economics

16910 (CONF-710935-1) USE OF OUTAGE STATISTICS FOR OPERATING AND SPINNING RESERVE ASSESSMENTS. Paper No. 71 CP 701-PWR. Anstine, L. T. (Baltimore Gas and Electric Co., Md.); Goode, S. C.; Ringlee, R. J.; Street, A. 10 May 1971. 6p. IEEE, New York $1.35.

From Joint power generation conference; St. Louis, Mo. (19 Sep 1971).

A description is presented of the techniques for developing the parameters for operating and spinning reserve risk assessment from EEI forced outage statistics. 6 references. (auth)

16911 (HEDL-TME-71-155) MODEL FOR ESTIMATING THE EFFECTS OF NUCLEAR PLANT CLUSTERING ON POWER TRANSMISSION COSTS. Omberg, Ronald P. (Hanford Engineering Development Lab., Richland, Wash.). Oct 1971. Contract AT(45-1)-2170. 14p. Dep. NTIS.

A model has been developed to calculate the minimum transmission cost between a set of supply and demand centers. The model uses the technique of Linear Programming, and is basically an economic tool. The problem of calculating the increase in

transmission cost caused by clustering of nuclear supply centers is then investigated, and the relative increase in transmission cost as a function of the degree of clustering and the skewness of the plant distribution is illustrated. (7 references) (auth)

16912 (RT/EC-(71)2) COST-BENEFIT ANALYSIS AND MARKET FORECASTS ON DIFFERENT NUCLEAR ELECTRICAL DEVELOPMENT PROGRAMS IN ITALY. Cicognani, G.; Comellini, O.; Tanzi, V.; Zironi, I. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy)). 12 Mar 1971. 87p. (In Italian). Dep. NTIS (U. S. Sales Only).

On the basis of a long term evaluation of electric energy requirements in Italy, the results of a cost-benefit analysis are presented in which the relative economical advantages of various power generating systems are assessed. Combinations among conventional plants, thermal (LWR, HWR) and fast (LMFBR) reactors are studied under several different hypotheses and some general conclusions are drawn. They pertain to the more economical strategies and to the market foreseen in Italy in the nuclear field in the next decades. The importance of the introduction of fast reactors is underlined not only as regards the overall energy program, but also for assessing the more convenient fuel policy for the next 15-20 years. 17 references. (auth)

16913 (WASH-1099) REACTOR FUEL CYCLE COSTS FOR NUCLEAR POWER EVALUATION. (Oak Ridge National Lab., Tenn.). Dec 1971. 260p. GPO $2.00.

As a part of an assessment of civilian nuclear power, a Systems Analysis Study of potential growth patterns of the U.S. central-station electric power generation system was conducted. In general terms, the main objective of the study was to estimate the relative extent to which existing and proposed types of nuclear power plants could be advantageously utilized in the total U.S. power generating system over the next 50 years. From the analysis it was hoped to establish the relative economic incentives for the development of the various nuclear reactor types. The Systems Analysis Study was based on a mathematical simulation model of the central-station power generating system growth over the selected time period. A linear programming procedure was used to calculate the optimal combination of fossil-fired and nuclear power plants as a function of time that would meet a given set of criteria preselected to demonstrate the influence on total system costs of such factors as availability of reactor and fuel type, uranium ore costs, total power growth rate, and the like. Comparisons of the total present-worthed costs of the various possible system growth patterns were used to indicate the potential economic benefits assignable to the different reactor types considered in the study. Among the costs that had to be included in the study were the fuel cycle costs of the nuclear reactors. The estimation of these costs was the chief mission of the Fuel Recycle Task Force (FRTF). The fuel cycle cost data provided as input to the Systems Analysis Study, the methods developed for estimating prices for fuel cycle services as a function of time, and the qualifications and limitations of the data and the methods are presented. (auth)

16914 SELECTING THE PARAMETERS OF A NUCLEAR/GAS TURBINE PLANT WITH A VARIABLE REACTOR CAPACITY. Saprykin, G. S.; Larin, E. A. (Saratov Polytechnical Inst., USSR). Thermal. Eng. (USSR) (Engl. Transl.); 17: No. 11, 43-7(Nov 1970).

Translated from Teploenergetika; 17: No. 11, 31-4(Nov 1970).

High temperature gas cooled reactors in combination with gas turbine plants are investigated. The optimal parameters are determined for such a plant in a case where the fuel element center temperature is a limiting factor and the reactor capacity and the fuel element can temperatures are variables. (H.D.R.)

16915 NUCLEAR POWER: PROSPECTS AND PROBLEMS. Winterson, Howard M. Combustion; 43: No. 6, 27-9(Dec 1971).

Advantages of nuclear power are discussed in terms of cost, safety, and freedom from air pollution. The most serious problem affecting the growth of nuclear power is examined. This problem is considered to be the delays in licensing caused by procedural and legal difficulties. (H.D.R.)

16916 RECENT PROGRESS IN MOLTEN-SALT REACTOR DEVELOPMENT. Rosenthal, M. W.; Haubenreich, P. N.; McCoy, H. E.; McNeese, L. E. (Oak Ridge National Lab., Tenn.). At. Energy Rev.; 9: No. 3, 601-50(1971).

Progress made in the development of molten-salt breeder reactors is reviewed since an overall review of molten-salt reactor technology was written about two years ago. Emphasis is placed on three areas in which advancements during this period have been most significant. These are: the final period of operation of the Molten-Salt Reactor Experiment, in which the reactor operated on ^{233}U but additions of plutonium were made to obtain experience with it as a MSR fuel; the modification of Hastelloy N, the preferred container and structural material for MSRs, to give it resistance to radiation damage at the full range of conditions expected in a power reactor; and the development of an improved process for the rapid removal of rare-earth fission products from the fuel salt. 63 references. (auth)

Safety and Siting

Refer also to abstract 15213.

16917 (EURFNR-937) SPREAD OF LOCAL DISTURBANCES IN THE CORE OF SODIUM-COOLED FAST BREEDERS AND ITS IMPORTANCE FOR REACTOR SAFETY. Gast, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-1380. 199p. Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The problem of propagation of local cooling disturbances and fuel element faults in the core of a sodium cooled fast breeder reactor is analyzed. Initial faults, their possible consequences and potential mechanisms to cause a nuclear accident are discussed with relation to failure trees and are weighed in their importance with regard to reactor safety. 82 references. (auth)

16918 (EURFNR-977) CONSIDERATIONS ON THE ACCIDENT: "WATER INGRESS IN THE PRIMARY LOOP OF A HELIUM COOLED FAST BREEDER REACTOR WITH SECONDARY STEAM CYCLE." Eisemann, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Sep 1971. 24p. (KFK-1487). Dep. NTIS (U. S. Sales Only).

Work performed under United States-Euratom Fast Reactor Exchange Program.

The rupture of a steam pipe in a heat exchanger of a gas cooled fast breeder reactor with a secondary steam cycle may lead to ingress of steam in the primary circuit. The amount of steam in the core region arising from such an accident is estimated. The dependence of the effective multiplication factor K_{eff} on the steam density in the core with different parameters such as the burnup condition, the group cross-section set, and the Pu isotopic composition is investigated. 4 references. (auth)

16919 (HMI-B-85) RELEASE OF FISSION PRODUCTS BY EXTREME ACCIDENTS OF NUCLEAR REACTORS. Jacobi, W.; Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jul 1969. 23p. (In German). Dep. NTIS (U. S. Sales Only).

The release of fission products into the atmosphere by postulated extreme loss-of-cooling accidents of nuclear power plants is estimated, taking into regard the plate-out of fission products in the containment. In extension of the "maximum credible accident" also a failure of the containment spray system, a breakdown of air filters and an increased leakage rate of the containment are considered. 16 references. (auth)

16920 (NP-19170) ELECTRIC POWER AND THE ENVIRONMENT. (Office of Science and Technology, Washington, D. C.). Aug 1970. 80p. GPO $0.75.

Information concerning the siting and operation of nuclear and steam power plants in the U. S. is presented under the following topics: present institutional arrangements and standard setting considerations; new institutional arrangements; transmission lines and utility corridors; acquisition of plant sites; research and development to alleviate problems of power plant siting; and considerations affecting the growth of electricity consumption. (D.C.C.)

16921 (SRD-R-4) TOPICAL REPORTS ON SAFETY QUESTIONS FOR LIGHT WATER REACTORS (1971). (United Kingdom Atomic Energy Authority, Risley (England). Safety and Reliability Directorate). 1971. 24p. Dep. NTIS (U. S. Sales Only).

Notes are presented on several topics which are believed to be the main questions affecting light water reactor safety. The notes are intended to provide insights and points of view rather than to be finally authoritative. The topics concerned are turbine stop valve closure, cold water accident, steam line break accident, and control rod drop accident for BWR's, and loss-of-coolant accident for both BWR and PWR systems. (auth) (UK)

16922 (WAPD-T-2474) FLASH-3 ANALYSIS OF THE LOFT SEMISCALE TEST 845. Murphy, J. H.; Redfield, J. A. (Bettis Atomic Power Lab., Pittsburgh, Pa.). [1971]. 15p. (CONF-711009-11). Dep. NTIS.

From Symposium on desalination, its scientific methods, economics, and importance for domestic and agricultural purposes; Cairo, Egypt (6 Nov 1971).

The FLASH-3 program was used to analyze LOFT Test No. 845, and the subsequent Test No. 846, based on the plant information contained in the semi-scale loop description. The analysis philosophy used in the calculations was to represent the interactions between the plant blowdown, water injection and core cooling by using a single FLASH-3 problem through all phases of the transient. The FLASH-3 model contains six nodes and ten flow paths, two of which are heated core paths. Loop characteristics such as the pressurizer, the circulating pump, a heat exchanger, the ECC system and the leak are represented explicitly. The results of the calculations are summarized. (auth)

16923 (WCAP-7835) LOCTA-R2 PROGRAM: LOSS OF COOLANT TRANSIENT ANALYSIS. Bezella, W. A.; Caso, C. L.; Spencer, A. C. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1972. 43p.

The LOCTA-R2 computer program is designed to calculate the detailed thermal conditions of the core during a loss-of-coolant accident. Throughout the transient, it is assumed that the flow and temperature at the bottom of the core are known as a function of time as obtained from a code such as FLASH or SATAN. With this information, LOCTA-R2 proceeds to determine fuel, cladding, and coolant temperatures, the degree of metal–water reaction, if this reaction occurs, and the energy release from the fuel rod, all as a function of time and axial location within the core. (11 references) (auth)

16924 COOLING WATER SOURCES FOR POWER GENERATION. Hauser, Louis G. (Westinghouse Electric Corp., East Pittsburgh). J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO1, 123-33(Jan 1971). (CONF-700121-1).

From National water resources engineering meeting; Memphis, Tenn. (26 Jan 1970).

The dissipation of residual heat from power reactors is discussed. The additional costs of alternate heat dissipation methods are analyzed. The percentage of future steam turbine plants that will encounter higher back pressures due to cooling water limitations is studied. Optimizing the cost of alternative cooling systems by analytical procedures is described. (auth)

16925 EARTHQUAKE RESEARCH NEEDS FOR NUCLEAR POWER PLANTS. Housner, George W. (California Inst. of Tech., Pasadena). J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO1, 77-91(Jan 1971). (CONF-691068-2).

From Annual and environmental conference; Chicago, Ill. (13 Oct 1969).

Requirements for safety dictate that nuclear power plants should be designed conservatively to withstand earthquake forces. On the other hand, excessive conservatism results in unwarranted cost. These aspects of the earthquake problem indicate the need for additional research to enable the true factor of safety to be defined more accurately and to reduce the cost of providing seismic resistance. The response of real structures and equipment to earthquake ground motions, as distinguished from the response of idealized models, is a very complex problem of dynamics, and to design for a specified factor of safety involves many difficulties. The design requirements of nuclear power plants bring these difficulties into special prominence. Some of the difficulties and questions that arise are presented. 6 references. (auth)

16926 SEISMIC ANALYSIS OF NUCLEAR POWER PLANT STRUCTURES. Bergstrom, Richard N.; Chu, Shih-lung; Small, Robert J. (Sargent and Lundy Engineers, Chicago). J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO2, 367-94(Mar 1971). (CONF-691068-1).

From Annual and environmental conference; Chicago, Ill. (13 Oct 1969).

The design of a nuclear power station to resist the effects of a strong motion earthquake represents one of the more significant considerations confronting the electric power generating industry today. The aseismic design consideration has necessitated significant technological advances within the industry, affecting not only the utilities, but their engineering consulting firms and the various equipment manufacturers. Current aseismic analysis techniques and their applications in nuclear power station design are described. 17 references. (auth)

16927 NUCLEAR REACTOR SAFETY: AN OPINION. Rasmussen, Norman C. (Massachusetts Inst. of Tech., Cambridge). Nucl. News; 15: No. 1, 35-7; 40(Jan 1972).

The loss of coolant accident in water cooled reactors is examined as an example of how reactor safety analyses are carried out. The engineering features of an emergency core cooling system are described, and the ability of calculational models to accurately predict the results of loss of coolant experiments is discussed. It is concluded that the risks to the public from the operation of nuclear power plants are not significant when compared to risks of other accepted activities in a technical society. The benefits of a cheaper, cleaner source of power far outweigh the small risks of severe nuclear accidents. 13 references. (H.D.R.)

16928 THERMOHYDRODYNAMIC MODEL FOR MOLTEN UO_2–Na INTERACTION, PERTAINING TO FAST REACTOR FUEL-FAILURE ACCIDENTS. Cronenberg, August William. Evanston, Ill.; Northwestern Univ. (1971). 150p. University Microfilms Order No. 71-30,772.

Thesis.

As part of the liquid-metal fast-breeder-reactor (LMFBR) safety program, the consequences of molten-fuel release into sodium coolant must be evaluated, such that design constraints might be established to minimize the safety hazard of such an event. As part of this effort both experimental and analytical work is being conducted. The work presented represents the first attempt to compare the voiding rates obtained from an in-pile, fuel-failure experiment, with theoretical results of a fuel-coolant interaction (FCI) model. Specifically the flowmeter data obtained from the H-2 TREAT (Transient Reactor Test Facility) failure experiment was compared with the calculated results of the analytic model developed. The theoretical approach taken was to seek a coupled solution to the energy and momentum equations of a single bubble which expands against an upper and lower liquid slug. The assumption is made that during the initial contact period, fuel fragmentation occurs as a result of violent boiling. Although a quantitative description of this breakup process has been bypassed, it is assumed that the resulting active region contains not only fuel and sodium liquid, but also sodium vapor. Within this bubble, finely divided fuel particles interact with sodium, resulting in vaporization and subsequent bubble growth. A thin liquid-film layer is assumed to adhere to the intact portions of the pin and test section, thus allowing for condensation at these surfaces. An analytic solution is obtained for the energy transport across the slug interfaces and fuel particles, while a simplified set of finite difference equations define the heat transfer across the film remaining on the pin and test-vessel walls. The expansion of the bubble is resisted by the inertia of the liquid slugs considering pressure differential, wall friction, gravity heat, and junction losses, however, neglecting compressibility effects. The model therefore represents the first analytic treatment of the energy exchange process at all boundaries of the expanding interaction zone. Parametric calculations were made considering the effects of particle size, condensation, and initial fuel-liquid-vapor volume fractions. The results indicate that it is not only possible to reduce in-pile data to a workable form, but also fairly easy to obtain a mockup of loop conditions for simple geometries. The ability of the model to predict the experimental voiding history at relatively low vapor expansion energies is encouraging. In addition, it has been shown that the formation of condensate at cold boundaries will significantly reduce the amount of energy imparted to the expanding vapor bubble, which in turn limits the extent of the thermal-to-mechanical energy conversion process. Likewise, the assumption of vapor generation during the fragmentation process significantly reduces the extent of the calculated initial pressure buildup. (Diss. Abstr. Int., B)

16929 TREATMENT OF WASTE WATERS IN NUCLEAR POWER STATIONS. Heitmann, H. G. Aufbereit.-Tech.; No. 5, 281-4(1971). (In German).

A survey is given of the quantities and activities of waste waters which are produced in a nuclear power station. The various applied methods of decontamination— such as distillation, mechanical filtration, ion exchange— as well as the concentration and finally the solidification of waste solutions are described. It is shown that all requirements with respect to environmental protection are satisfied. (INIS)

16930 INFLUENCE OF THE COVER GAS ON THE EXPLOSION PRESSURE IN A URANIUM METAL, SODIUM FAST REACTOR. Sobrero, E. (Univ. Cattedra di Impianti Nucleari, Bologna). Energ. Nucl. (Milan); 19: No. 1, 26-35(Jan 1972). (In Italian).

The influence of the cover gas nature upon the explosion pressure in an uncontrolled nuclear excursion is studied. The system referred to is an adiabatic metallic uranium-sodium-cover gas system, as in a sodium fast reactor. It is shown that in the presence of a monatomic cover gas the maximum explosion pressure is reached assuming that no sodium vaporization occurs. In the presence of a biatomic cover gas and above a given amount of released energy per unit volume of the system, the maximum explosion pressure is reached assuming that some amount of sodium vaporizes (depending on the mass of uranium and cover gas). Other conditions being equal, the maximum explosion pressure with a biatomic cover gas is always lower than with a monoatomic gas. (20 references) (auth)

16931 LOCATION OF LARGE POWER PLANTS 1970–2000. Sv. Kraftverksfoereningens Publ.; No. 1, 36p(1971). (In Swedish).

Demands for and resources of land and water for large power plants in Sweden are described. Electric consumption to the year 2,000 is forecast, and this prognosis is compared with earlier location factors for large power plants. (INIS)

Steam and Power Conversion System

16932 (EURFNR–930) ASSEMBLY OF THE CIRCUIT COMPONENTS FOR A 1000-MWe PLANT WITH GAS-COOLED FAST BREEDER REACTOR AND GAS TURBINE. Artz, D.; Savatteri, C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report PSB–388/71. 18p. Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The main components (heat exchanger, cooler, turbine and compressor) of the 1000 MW(e) plant with helium turbine which is linked directly to a helium-cooled fast breeder reactor are analyzed. From the results of the first provisional optimization calculation it can be said that no major difficulties are to be expected for the components since the size of the heat exchanging equipment is convenient and since no cooling is required for the turbine blades due to the turbine inlet temperature of 706°C. With this temperature and with the materials available, the blades can be designed for a service life of 10^5 hrs without encountering strength difficulties. The single-shaft turbo set is to have a length of about 25 m and a maximum cylinder diameter of about 5 m. The aspects of the various assembly possibilities for the components are explained. A fully integrated design is proposed. (auth)

Commercial Power Reactors

16933 (FIND–50285(1-72)) FIND: FORT CALHOUN STATION, UNIT NO. 1. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 21 Jan 1972. 19p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

16934 (FIND–50376(12-71)) FIND: AGUIRRE NUCLEAR PLANT, UNIT NO. 1. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 30 Dec 1971. 12p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

16935 SITUATION OF THE CONSTRUCTION OF NUCLEAR POWER STATIONS IN THE WORLD. Bede, Gabor (Muszaki Egyetem, Budapest). Energ. Atomtech.; 24: No. 9, 385–9(Sep 1971). (In Hungarian).

The present state of the construction of nuclear power stations is outlined. The economic competition of construction of both fossil and nuclear power plants is dealt with. (18 references) (auth)

Control and Instrumentation

16936 (AED-CONF–71-100-35) EXPERIENCE WITH FUEL ELEMENTS FOR THE REACTOR POWER STATIONS KAHL (VAK), GUNDREMMINGEN (KRB), AND LINGEN (KWL). Fricke, W. May 1971. 13p. (CONF-710901–529). Dep. NTIS (U. S. Sales Only).

From 4. international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

16937 (DOCKET-50130–12) PATHFINDER GENERATING PLANT, SIOUX FALLS, SOUTH DAKOTA. Deviations from the Dismantling Work Schedule. (Northern States Power Co., Minneapolis, Minn.). 27 Aug 1971. 2p. Dep. NTIS.

16938 (DOCKET-50250–63) TURKEY POINT PLANT, UNIT 3. Corrective Action Concerning the Fabrication of Fuel. (Division of Compliance (AEC), Washington, D. C.). 12 Nov 1971. 11p. Dep. NTIS.

16939 (WCAP–7833) DESIGN AND PERFORMANCE EVALUATION OF THE ICE CONDENSER REACTOR CONTAINMENT SYSTEM FOR THE DONALD C. COOK NUCLEAR PLANT. McCurdy, W. J.; Weems, S. J.; Boettinger, W. L.; Bordelon, F. M.; Dorrycott, J. W.; Grimm, N. P.; Iredale, A. J. F.; Lyman, W. G.; Oft, R. R.; van Seuren, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa.). Mar 1968. 131p.

The design characteristics and performance analysis of the ice condenser system being applied to the reactor containments for the twin-unit, Donald C. Cook Nuclear Plant are presented. Information covering the influence of the ice condenser on the reactor containment and engineered safeguards systems is included. (auth)

16940 (WCAP–7833(Suppl.1)) DESIGN AND PERFORMANCE EVALUATION OF THE ICE CONDENSER REACTOR CONTAINMENT SYSTEM FOR THE DONALD C. COOK NUCLEAR PLANT. McCurdy, W. J.; Weems, S. J.; Boettinger, W. L.; Dorrycott, J. W.; Grimm, N. P.; Iredale, A. J. F.; Lyman, W. G. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jul 1968. 60p.

Information concerning the mechanical design and performance analysis of the ice condenser containment system for the Donald C. Cook Power Reactor Units 1 and 2 is presented. (D.C.C.)

16941 (WCAP–7833(Suppl.2)) DESIGN AND PERFORMANCE EVALUATION OF THE ICE CONDENSER REACTOR CONTAINMENT SYSTEM. McCurdy, H. W.; Weems, S. J.; Bordelon, F. M.; Grimm, N. P.; Kilpela, E. J.; Lyman, W. G. (Westinghouse Electric Corp., Pittsburgh, Pa.). Aug 1969. 49p.

Information concerning the performance analysis and transient pressure analysis of the ice condenser containment system for the Donald C. Cook Power Reactor Units 1 and 2 is presented. 6 references. (D.C.C.)

16942 CONTAINMENT STRUCTURE FOR TROJAN NUCLEAR PLANT. Aldersebaes, Jacob K. (Portland General Electric Co., Oreg.); Wiedner, Karl. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO2, 351–66(Mar 1971). (CONF-700451–1).

From National meeting on structural engineering; Portland, Oreg. (6 Apr 1970).

The Trojan Nuclear Plant will have a 1,130-MW output, which makes it one of the largest plants constructed to date of this type. The nuclear steam supply system will be a four loop pressurized water reactor. The reactor, together with its four steam generators and four recirculation pumps, pressurizer and other auxiliary equipment, is located inside a post-tensioned concrete containment structure, designed to provide maximum safety to the public and prevent the accidental release of radioactivity to the environment. Design characteristics of the containment structure are presented. 7 references. (auth)

16943 COOLING WATER STRUCTURES FOR FITZPATRICK NUCLEAR PLANT. Gunwaldsen, Ralph W. (Stone and Webster Engineering Corp., Boston); Brodfeld, Bruno; Hecker, George E. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO–4, 767–81 (Dec 1971).

The James A. FitzPatrick Nuclear Power Plant is the first nuclear unit for the Power Authority of the State of New York. Field, model, and analytic studies were conducted to develop cooling discharge and intake structures which would meet the stringent thermal criteria recently adopted by New York State. These studies have resulted in the design of a discharge structure based on the concept of submerged multiple jets. Although this is not a new concept, its application for thermal discharges from power plants into large but slow moving bodies of water represents a new development. 10 references. (auth)

Operation and Economics

16944 (DOCKET-1155–152) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Shutdown, Low/Recirculation Flow Scram. (Dairyland Power Cooperative, La Crosse, Wis.). 11 Jan 1972. 3p. (DPC–72-1). Dep. NTIS.

16945 (DOCKET-1155–159) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, August 1971. (Dairyland Power Cooperative, La Crosse, Wis.). 5 Nov 1971. Contract AT(11-1)-851. 27p. (TID–25860; DPC–851–33). Dep. NTIS.

16946 (DOCKET-1155–160) LA CROSSE BOILING WATER REACTOR. Component Failure in Turbine Steam System. (Dairyland Power Cooperative, La Crosse, Wis.). 20 Jan 1972. 6p. Dep. NTIS.

16947 (DOCKET-1155–161) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, November 1971. (Dairyland Power Cooperative, La Crosse, Wis.). Nov 1971. Contract AT(11-1)-851. 25p. (DPC–851–37). Dep. NTIS.

16948 (DOCKET-50010–103) DRESDEN NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change. (Commonwealth Edison Co., Chicago, Ill.). 8 Feb 1972. 30p. Dep. NTIS.

Revised technical specifications are presented concerning primary system leakage, primary containment leak rate testing, emergency core cooling system requirements and surveillance, and off-gas emissions. (D.C.C.)

16949 (DOCKET-50016-143) ENRICO FERMI ATOMIC POWER PLANT. Order Extending Provisional Operating License Expiration Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 25 Jan 1972. 2p. Dep. NTIS.

16950 (DOCKET-50016-144) ENRICO FERMI ATOMIC POWER PLANT. Technical Specifications Request for Change. (Power Reactor Development Co., Detroit, Mich.). 1 Feb 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the positioning of the core holddown mechanism during the repair of a liquid sodium leak. (D.C.C.)

16951 (DOCKET-50016-146) ENRICO FERMI ATOMIC POWER PLANT. Technical Specifications, Change No. 18. (Division of Reactor Licensing (AEC), Washington, D. C.). 10 Feb 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning maintenance activities. (D.C.C.)

16952 (DOCKET-50029-165) YANKEE NUCLEAR POWER STATION. Operation Report No. 132, December 1971. (Yankee Atomic Electric Co., Westboro, Mass.). 20 Jan 1972. 8p. Dep. NTIS.

16953 (DOCKET-50130-13) PATHFINDER GENERATING PLANT. Order Extending Provisional Operating License Expiration Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 9 Sep 1971. 2p. Dep. NTIS.

16954 (DOCKET-50133-75) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Technical Specifications, Change No. 38. (Pacific Gas and Electric Co., San Francisco, Calif.). 26 Jan 1972. 4p. Dep. NTIS.

A change in the Technical Specifications for the Humboldt Bay power reactor to allow a reactivity discrepancy limit equal to one percent in reactivity during steady state operation is proposed. (H.D.R.)

16955 (DOCKET-50133-77) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Technical Specifications, Change No. 37 (Proposed Change No. 38). (Division of Reactor Licensing (AEC), Washington, D. C.). 9 Feb 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning reactivity discrepancy limit and surveillance requirements for reactivity anomalies. (D.C.C.)

16956 (DOCKET-50206-141) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Items for Consideration and Apparent Noncompliance. (Division of Compliance (AEC), Washington, D. C.). 29 Nov 1971. 13p. Dep. NTIS.

Additional information is presented concerning the in-line monitoring of liquid radioactive effluents. (D.C.C.)

16957 (DOCKET-50206-142) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specification, Change No. 6, Supplement No. 1. (Division of Reactor Licensing (AEC), Washington, D. C.). 19 Jan 1972. 4p. Dep. NTIS.

Revised technical specifications are presented concerning organizational changes within the utility companies operating the reactor. (D.C.C.)

16958 (DOCKET-50206-147) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Operation Report, October 1971. (Southern California Edison Co., Rosemead, Calif.). 9 Nov 1971. Contract AT(30-1)-3270. 6p. (NYO-3270-55). Dep. NTIS.

16959 (DOCKET-50206-148) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Safety Injection Recirculation System Valve Difficulties. (Southern California Edison Co., Rosemead, Calif.). 28 Jan 1972. 5p. Dep. NTIS.

16960 (DOCKET-50213-129) HADDAM NECK PLANT. Exposure of Personnel to Airborne ^{131}I on April 18-22, 1971. (Division of Compliance (AEC), Washington, D. C.). 19 Oct 1971. 2p. Dep. NTIS.

16961 (DOCKET-50213-131) HADDAM NECK PLANT. Operation Report No. 71-12, December 1971. (Connecticut Yankee Atomic Power Co., Haddam). 24 Jan 1972. Contract AT(30-1)-3250. 16p. (NYO-3250-67). Dep. NTIS.

16962 (DOCKET-50213-133) HADDAM NECK PLANT. Abnormal Occurrence No. 72-1, Containment Air Leakage in Excess of Limit Specified. (Connecticut Yankee Atomic Power Co., Hartford). 28 Jan 1972. 6p. Dep. NTIS.

16963 (DOCKET-50237-215) DRESDEN NUCLEAR POWER STATION, UNIT 2. Information Concerning Refueling Outage. (Commonwealth Edison Co., Chicago, Ill.). 2 Feb 1972. 6p. Dep. NTIS.

16964 (DOCKET-50244-86) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Detection of Inoperative Bistable During Monthly Surveillance Test. (Rochester Gas and Electric Corp., N. Y.). 27 Jan 1972. 2p. Dep. NTIS.

16965 (DOCKET-50244-87) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Detection of Faulty Relay During Surveillance Test. (Rochester Gas and Electric Corp., N. Y.). 7 Feb 1972. 1p. Dep. NTIS.

The failure of an underfrequency relay on the 4169 Kv bus No. 11B is analyzed. Replacement of the relay is described. (D.C.C.)

16966 (DOCKET-50244-88) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Detection of Nuclear Power Channel Drift. (Rochester Gas and Electric Corp., N. Y.). 7 Feb 1972. 1p. Dep. NTIS.

16967 (DOCKET-50245-114) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Semiannual Operation Report, January 1-June 30, 1971, Revised. (Millstone Point Co., Hartford, Conn.). 12 Jan 1972. 75p. Dep. NTIS.

16968 (DOCKET-50255-68) PALISADES PLANT. Incident Involving the Motor Package of Control Rod Drive Mechanism. (Consumers Power Co., Jackson, Mich.). 7 Feb 1972. 2p. Dep. NTIS.

16969 (DOCKET-50261-84) H. B. ROBINSON UNIT NO. 2. Technical Specification, Change No. 6 Implemented. (Division of Reactor Licensing (AEC), Washington, D. C.). 15 Oct 1971. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the testing schedule for the 4 kV bus underfrequency coolant pump trip circuits. (D.C.C.)

16970 (DOCKET-50261-85) H. B. ROBINSON UNIT NO. 2. Failure of B Diesel to Start During Weekly Test. (Carolina Power and Light Co., Raleigh, N. C.). 14 Jan 1972. 1p. Dep. NTIS.

16971 (DOCKET-50263-103) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of Diesel Generator to Start. (Northern States Power Co., Minneapolis, Minn.). 25 Jan 1972. 1p. Dep. NTIS.

16972 (DOCKET-50263-104) MONTICELLO NUCLEAR GENERATING PLANT, UNIT. Malfunction of Core Spray Injection Valve. (Northern States Power Co., Minneapolis, Minn.). 28 Jan 1972. 3p. Dep. NTIS.

16973 (DOCKET-50263-105) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Reset Failure of D Reactor Safety Relief Valve. (Northern States Power Co., Minneapolis, Minn.). 28 Jan 1972. 3p. Dep. NTIS.

16974 (DOCKET-50285-56) FORT CALHOUN STATION, UNIT NO. 1. Application for Licenses, Amendment No. 32. (Omaha Public Power District, Nebr.). 27 Jan 1972. 117p. Dep. NTIS.

Financial data on the owners of the Fort Calhoun Power Reactor Unit 1 are presented. (D.C.C.)

16975 (DOCKET-50309-49) MAINE YANKEE ATOMIC POWER STATION. License Application, Amendment No. 31. (Maine Yankee Atomic Power Co., Augusta). 17 Nov 1971. 214p. Dep. NTIS.

Cost estimates for operating the Maine Yankee Power Reactor for a five year period are presented. Financial data on the owners are also included. (D.C.C.)

16976 (DOCKET-50309-50) MAINE YANKEE ATOMIC POWER STATION. License Application, Amendment No. 31, Supplement No. 1. (Maine Yankee Atomic Power Co., Augusta). 1 Dec 1971. 32p. Dep. NTIS.

Financial data on the owners of the Maine Yankee Power Reactor are presented. (D.C.C.)

16977 (EUR-4717) 50 MWe DODEWAARD NUCLEAR POWER PLANT. Annual Report, 1970. (Gemeenschappelijke Kernenergiecentrale Nederland N.V., Dodewaard, Samenwerkende Electriciteits-Productiebedrijven, N. V., Arnhem (Netherlands)). Nov 1971. 90p. (In Dutch). Dep. NTIS (U. S. Sales Only). EUR Fl. 9,-.

The year 1970 was the second complete operational year for the first Dutch nuclear power plant. Operational experience continued to be satisfactory. Apart from the two major unscheduled shutdowns, which were due to the need to remove the temporary absorption plates and to do work on the turbine unit in order to improve the efficiency of the plant, the availability was 98.3%. During the last three months of the year no faults necessitating a plant shutdown occurred. The availability for 1970 was 81.5%

as compared with 73.5% in 1969. The management of the power plant is reviewed. The maintenance and repair work, the reactor physics and chemical aspects of operation and the radiation monitoring are described. (auth)

16978 OPERATING EXPERIENCE IN ITALIAN NUCLEAR POWER PLANTS. Angelini, A. M. (ENEL, Rome). Energ. Nucl. (Milan); 18: No. 11, 588-96(Nov 1971).

Since 1963-1964 three nuclear power plants have been in operation in Italy, namely, Latina (Magnox, 210 MW(e)), Garigliano (BWR, 160 MW(e)) and Trino Vercellese (PWR, 256 MW(e)). At the end of November 1970, the three stations had generated over 20,000 million kWh. The main operating data since commissioning of the three plants are provided (output, load factor, availability factor, main outages and related reasons, major modifications and repairs, etc.). The failures that have most affected service continuity and reliability, the problems that had to be solved in order to perform some of the repairs, the inspection, control and maintenance procedures adopted and the behavior of the main components of the three plants are reviewed and commented. The paper expounds and analyzes the conclusions to be drawn from past operating experience and examines the role played by the three plants in furthering the progress and establishment of the large nuclear plants of the new generation. A few considerations are made on the validity of the acquired experience for the purpose of evaluating the performance of new nuclear plants from the standpoint of plant safety and service continuity and reliability. (auth)

16979 NUCLEAR POWER AND RELATED ENERGY PROBLEMS, 1968 THROUGH 1970. REPORT OF JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, DECEMBER 1971. Washington, D. C.: Joint Committee on Atomic Energy (1971). 1120p. GPO $4.50.

The comments and views of organizations and individuals from industry, government, conservation organizations, and research foundations on the economics of nuclear power and on questions involving electric power and the environment are presented. Significant supplementary material on energy problems is included in the appendixes. (H.D.R.)

16980 NUCLEAR ENERGY IN ELECTRIC POWER GENERATION IN THE EUROPEAN COMMUNITY. Atomwirt., Atomtech.; 17: No. 1, 23(Jan 1972). (In German).

The total electric power generation by the European community is analyzed by source: water power, earth heat (Italy), nuclear power, and traditional heat sources. The fraction stemming from nuclear plants rose in one year from 0.5% to 2.8%. Generated MW is also tabulated by country. (K.S.W.)

Safety and Siting

16981 (CEA-CONF-1877) RADIOLOGICAL SAFETY OF FRENCH REACTORS AND THEIR SITES. Candes, P. ([Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires]). [1971]. 12p. (In French). (CONF-710444-2). Dep. NTIS (U. S. Sales Only).

From International conference on chemical sciences; Paris, France (20 Apr 1971).

The general principles of reactor safety are discussed. Safety studies relating to the maximum credible accident with the Phenix reactor are presented. Experimental studies led to an estimation of the retention of contamination by the surrounding environment. 5 references. (France)

16982 (DOCKET-1151-51) ELK RIVER REACTOR. Removal and Disposal of Pressure Vessel Internals. (Rural Cooperative Power Association, Elk River, Minn.). 24 Jan 1972. Contract AT(11-1)-651. 2p. Dep. NTIS.

16983 (DOCKET-1155-153) LA CROSSE BOILING WATER REACTOR. Information on the Main Steam Isolation Valves. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 18 Jan 1972. 2p. Dep. NTIS.

16984 (DOCKET-1155-154) LA CROSSE BOILING WATER REACTOR. Metallurgical Investigation of Components Removed from System. (Southwest Research Inst., San Antonio, Tex.). 13 Nov 1970. 49p. (SWRI-1228-P-12-3). Dep. NTIS.

An investigation of seven stainless steel components removed from the LaCrosse Boiling Water Reactor (LACBWR) is described. A section of feedwater piping, an emergency core spray nozzle consisting of a piece of piping, a coupling, and a "safe-end," and five "safe-ends" from main steam, decay heat, and purification nozzles are examined. Of these components, only the feedwater piping and the piping side of the emergency core spray nozzle had normal microstructures and exhibited acceptable behavior in accelerated corrosion and metallographic etch tests. All of the "safe-ends" were found to have sensitized microstructures and suffered moderate to severe intergranular attack in accelerated corrosion and metallographic etch tests. An electron microprobe analysis was made of the surface of crevice areas of the "safe-ends" from two feedwater inlet nozzles to determine if a correlation existed between copper concentration in the crevices and cracking in these "safe-ends." Considerably greater copper concentrations were found in the crevices of the "safe-ends" which cracked than in the crevice of a "safe-end" which did not crack, suggesting a relation between copper concentration and cracking. (15 references) (auth)

16985 (DOCKET-1155-155) LA CROSSE BOILING WATER REACTOR. Replacement of Sensitized Safe-Ends on the Decay Heat Cooler and Installation of Meter Taps on the Main Steam Line. (Dairyland Power Cooperative, La Crosse, Wis. Southwest Research Inst., San Antonio, Tex.). 20 Oct 1971. 64p. Dep. NTIS.

It was determined that the austenitic stainless steel "safe-ends" on the decay heat cooler had been subjected to a post-weld stress-relieving operation and were, thus, in a sensitized condition. The "safe-ends" were removed and replaced with annealed austenitic stainless steel. In addition, some limited repair work was performed on the cooler channel head and eight meter taps were installed in the main stream line. A quality control plan was implemented to insure that qualified materials were used and that the removal, installation, and inspections operations were performed by qualified personnel. (auth)

16986 (DOCKET-1155-156) LA CROSSE BOILING WATER REACTOR. Reactor Vessel Head Flange Stud Failure. (Southwest Research Inst., San Antonio, Tex.). Dec 1971. Contract AT(11-1)-2154. 161p. (SWRI-2154-20). Dep. NTIS.

16987 (DOCKET-1155-157) LA CROSSE BOILING WATER REACTOR. Surveillance and Inspection Programs for Pressure Vessel and Associated Piping and Equipment Corrosion Program. (Southwest Research Inst., San Antonio, Tex.). 25 Feb 1971. Contract AT(11-1)-1228. 40p. Dep. NTIS.

An investigation of the corrosion rate of A335, P-11 steel used in the forced-circulation piping of the LaCrosse Boiling Water Reactor (LACBWR) is described. Corrosion specimens were inserted in the piping and wall-thickness baseline data were taken before the reactor was placed in service. The first examination of corrosion specimens after installation and the first wall thickness measurements made since baseline data were determined are presented. The results of the program show that A335, P-11 steel possesses good general corrosion resistance in stagnant water; the material is subject to crevice corrosion; the material appears to be subject to erosion in flowing water; and the ultrasonic technique used to measure wall thickness is accurate to about ±0.020 inch. (auth)

16988 (DOCKET-1155-158) LA CROSSE BOILING WATER REACTOR. Metallurgical Investigation of Cracking in Feedwater Inlet Nozzel "Safe Ends." (Southwest Research Inst., San Antonio, Tex.). 16 Mar 1970. Contract AT(11-1)-1228. 70p. Dep. NTIS.

An investigation of four sensitized stainless steel "safe-ends" removed from the feedwater nozzles which were welded to one of the recirculating headers of the LaCrosse Boiling Water Reactor (LACBWR) is described. Visual and metallographic examinations revealed extensive intergranular cracking in the Type 304 stainless steel "safe-ends" of two of the nozzles. Cracking was most severe in a crevice area formed by the "safe-end" and a thermal sleeve welded to it; however, cracking was also found outside the crevice area. Etch tests and accelerated corrosion tests established a strong correlation between the cracking and severe sensitization of the "safe-ends" which resulted from furnace stress-relieving the header. (8 references) (auth)

16989 (DOCKET-50003-97) INDIAN POINT STATION, UNIT 1. Condition of Reactor Vessel. (Consolidated Edison Co. of New York, Inc., New York). 28 Jan 1972. 10p. Dep. NTIS.

16990 (DOCKET-50010-102) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. QUAD-CITIES STATION, UNITS 1 AND 2. Main Steam Isolation Valves. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 18 Jan 1972. 2p. (DOCKET-50237-213; DOCKET-50249-116; DOCKET-50254-63; DOCKET-50265-55). Dep. NTIS.

16991 (DOCKET-50016-142) ENRICO FERMI ATOMIC POWER PLANT. Technical Specification Change No. 23 Implemented. (Division of Reactor Licensing (AEC), Washington, D. C.). 13 Sep 1971. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the reuse of eleven Core A fuel and inner radial blanket subassemblies. (D.C.C.)

16992 (DOCKET-50016–145) ENRICO FERMI ATOMIC POWER PLANT. Technical Specifications, Change No. 17. (Division of Reactor Licensing (AEC), Washington, D. C.). 7 Feb 1972. 1p. Dep. NTIS.

Revised technical specifications are presented concerning the position of the core holddown mechanism. (D.C.C.)

16993 (DOCKET-50133–74) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Difficiencies in Radiation Protection Procedures and Practices. (Pacific Gas and Electric Co., San Francisco, Calif.). 19 Nov 1971. 16p. Dep. NTIS.

Detailed responses are presented in answer to alleged items of noncompliance with license requirements at the Humboldt Bay Power Plant. The first item concerns radiation protection aspects of the entry of plant personnel into the reactor cleanup pump area on June 21, 1970. The second item involves failure to notify two former employees of their accumulated occupational radiation exposure within 90 days of their discharge. (H.D.R.)

16994 (DOCKET-50133–76) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Shift in Set Point of the Condenser Low Vacuum Reactor Trip Sensors. (Pacific Gas and Electric Co., San Francisco, Calif.). 1 Feb 1972. 2p. Dep. NTIS.

16995 (DOCKET-50146–104) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Technical Specifications, Change Report No. 28. (Saxton Nuclear Experimental Corp., Pa.). 2 Feb 1972. 9p. Dep. NTIS.

Revised technical specifications are presented concerning the expected operating lifetime of Core 3. (D.C.C.)

16996 (DOCKET-50155–99) BIG ROCK POINT NUCLEAR PLANT. Main Steam Isolation Valves. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 18 Jan 1972. 2p. Dep. NTIS.

16997 (DOCKET-50155–100) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Request for Change No. 28. (Consumers Power Co., Jackson, Mich.). 21 Jan 1972. 10p. Dep. NTIS.

A change in the Technical Specifications for the Big Rock Point reactor is requested to allow the use of both the original design and redesigned fuel channel and support tube assemblies. The wording governing the stack release rate limits of ^{131}I is changed so that the literal interpretation is consistent with the intent of the specifications. (H.D.R.)

16998 (DOCKET-50171–98) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Inspection of Emergency Shutdown Rod Batteries. (Philadelphia Electric Co., Pa.). 25 Jan 1972. 3p. Dep. NTIS.

16999 (DOCKET-50206–143) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Preliminary Hazards Summary Report. (Southern California Edison Co., Los Angeles). 16 Jul 1964. 596p. Dep. NTIS.

Information concerning radioactive discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Hazards analysis for the reactor is included. Seismological data for the reactor site are also included. Financial data on the owners are presented. (D.C.C.)

17000 (DOCKET-50206–144) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Vibration Tests. (California Univ., Los Angeles. School of Engineering and Applied Science). Aug 1970. 118p. Dep. NTIS.

17001 (DOCKET-50206–145) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Supplementary Vibration Tests. (California Univ., Los Angeles. School of Engineering and Applied Science). Dec 1970. 29p. Dep. NTIS.

17002 (DOCKET-50206–146) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Response to Earthquakes. (California Univ., Los Angeles. School of Engineering and Applied Science). Jul 1971. 47p. Dep. NTIS.

17003 (DOCKET-50213–130) HADDAM NECK PLANT. Actions Taken with Respect to Main Steam Safety Valve Header Installation. (Division of Compliance (AEC), Newark, N. J. Region I). 20 Jan 1972. 5p. Dep. NTIS.

17004 (DOCKET-50213–132) HADDAM NECK PLANT. Main Steam Safety/Relief Valve Installation. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Jan 1972. 6p. Dep. NTIS.

17005 (DOCKET-50219–163) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Activities Not in Full Compliance with License Requirements. (Jersey Central Power and Light Co., Morristown, N. J.). 16 Sep 1971. 9p. Dep. NTIS.

A response to questions concerning activities not in full compliance with the Oyster Creek-1 reactor licensing requirements is presented. The activities include the methods used in surveys of radioactivity in liquid wastes, monitoring equipment for the radioactive liquid effluent, and variations in the performance of the liquid radioactive waste systems. Information is requested on the operation of the chemical waste system. (H.D.R.)

17006 (DOCKET-50219–165) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Technical Specifications Change No. 8 Implemented. (Division of Reactor Licensing (AEC), Washington, D. C.). 6 Oct 1971. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the removal of average power range monitors from service during replacement of detectors in the refueling mode. (D.C.C.)

17007 (DOCKET-50219–166) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Technical Specifications, Change No. 3. (Division of Reactor Licensing (AEC), Washington, D. C.). 8 Feb 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning instrumentation made inoperable for required tests and calibration. (D.C.C.)

17008 (DOCKET-50220–80) NINE MILE POINT NUCLEAR STATION. Items in Apparent Noncompliance with License Requirements. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 14 Sep 1972. 8p. Dep. NTIS.

A response to questions concerning activities not in full compliance with the Nine Mile Point reactor licensing requirements is presented. The questions and answers discuss the operation of the liquid radioactive waste system, the total activity discharged in liquid effluents, an incident of exposure of an employee to airborne radioactivity, and the scope of radioactivity buildup in aquatic edible animals. (H.D.R.)

17009 (DOCKET-50220–81) NINE MILE POINT NUCLEAR STATION, UNIT NO. 1. Station has Two Hydro-Line Manufacturing Company Main Steam Isolation Valve Operators. (Division of Compliance (AEC), Newark, N. J. Region I). 5 Jan 1972. 6p. Dep. NTIS.

17010 (DOCKET-50237–214) DRESDEN NUCLEAR POWER STATION, UNIT 2. Technical Specifications, Proposed Change No. 17. (Commonwealth Edison Co., Chicago, Ill.). 31 Jan 1972. 10p. Dep. NTIS.

Revised technical specifications are presented concerning the inservice inspection program. (D.C.C.)

17011 (DOCKET-50244–85) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Installation of Safety Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 10 Jan 1972. 4p. Dep. NTIS.

17012 (DOCKET-50247–58) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Supplemental Information to Report Dated December 6, 1971. (Division of Compliance (AEC), Newark, N. J. Region I). 19 Jan 1972. 3p. Dep. NTIS.

Additional information is presented concerning the strength and fire resistance of cable splices for the electrical system. (D.C.C.)

17013 (DOCKET-50247–59) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Technical Specifications, Change Requested. (Consolidated Edison Co. of New York, Inc., New York). 26 Jan 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the position of valves in the chemical and volume control system, sampling system, and emergency core cooling system. The closed position for these valves is required to prevent water with boron concentration below 2000 ppM from entering the coolant system. (D.C.C.)

17014 (DOCKET-50247–60) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Request that Piping Modifications to the High-Head Safety Injection System be Acceptable. (Consolidated Edison Co. of New York, Inc., New York). 7 Feb 1972. 13p. Dep. NTIS.

17015 (DOCKET-50247–61) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Order Extending Completion Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 14 Feb 1972. 2p. Dep. NTIS.

17016 (DOCKET-50250-64) TURKEY POINT PLANT, UNIT 3. Containment Dome Concrete Replacement Report. (Florida Power and Light Co.). 26 Jan 1972. 210p. Dep. NTIS.

17017 (DOCKET-50250-65) TURKEY POINT PLANT, UNITS 3 AND 4. Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of Operating Licenses. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). Feb 1972. 124p. (DOCKET-50251-56). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Cost-benefit analysis for the reactor is presented. Biological, geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

17018 (DOCKET-50254-64) QUAD-CITIES STATION, UNITS 1 AND 2. Discussions and Conclusions Supporting Issuance of Licenses Authorizing 20 Percent Operation. (Division of Reactor Licensing (AEC), Washington, D. C.). 26 Jan 1972. 69p. (DOCKET-50265-56). Dep. NTIS.

17019 (DOCKET-50254-65) QUAD-CITIES STATION, UNIT 1. Technical Specifications, Amendment No. 1. (Commonwealth Edison Co., Chicago, Ill.). 27 Jan 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the possession limit of antimony-124 radiation sources. (D.C.C.)

17020 (DOCKET-50259-35) BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 18. (Tennessee Valley Authority, Chattanooga). 27 Jan 1972. 93p. (DOCKET-50260-34; DOCKET-50296-32). Dep. NTIS.

Revised and additional data are presented concerning protection system instrumentation and the preoperational and startup testing programs. (D.C.C.)

17021 (DOCKET-50259-36) BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3. Radiological Emergency Plan. (Tennessee Valley Authority, Chattanooga). 20 Dec 1971. 315p. (DOCKET-50260-35; DOCKET-50296-33). Dep. NTIS.

17022 (DOCKET-50261-86) H. B. ROBINSON UNIT NO. 2. Findings on Inspection, September 29, 1971-October 1, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 27 Jan 1972. 2p. Dep. NTIS.

Results of inspections are presented concerning reactor trip breaker failures. (D.C.C.)

17023 (DOCKET-50263-102) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Information on Main Steam Isolation Valves. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 18 Jan 1972. 3p. Dep. NTIS.

17024 (DOCKET-50263-106) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Significant Variation in Core Reactivity Calculation. (Northern States Power Co., Minneapolis, Minn.). 3 Feb 1972. 3p. Dep. NTIS.

17025 (DOCKET-50265-57) QUAD-CITIES STATION, UNIT NO. 2. Order Extending Provisional Construction Permit to January 1, 1973. (Division of Reactor Licensing (AEC), Washington, D. C.). 21 Jan 1972. 2p. Dep. NTIS.

17026 (DOCKET-50266-59) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Expansion of Radiological Monitoring Studies. (Wisconsin Electric Power Co., Milwaukee). 31 Jan 1972. 2p. (DOCKET-50301-48). Dep. NTIS.

17027 (DOCKET-50266-60) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Supplemental Detailed Statement on Environmental Considerations Related to Proposed Issuance of an Operating License. (Wisconsin Electric Power Co., Milwaukee). 10 Feb 1972. 87p. (DOCKET-50301-49). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Cost-benefit analysis for the reactor is presented. Biological, geological, hydrological, and meteorological data for the reactor site are included. (D.C.C.)

17028 (DOCKET-50267-38) FORT ST. VRAIN NUCLEAR GENERATING STATION. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). 20 Jan 1972. 89p. Dep. NTIS.

17029 (DOCKET-50269-46) OCONEE NUCLEAR STATION, UNIT NO. 1. Supplementary Notice of Proposed Issuance of Facility Operating License. (Division of Reactor Licensing (AEC), Washington, D. C.). 9 Feb 1972. 4p. Dep. NTIS.

17030 (DOCKET-50271-71) VERMONT YANKEE NUCLEAR POWER STATION. Notice of Availability of Applicants Supplemental Environmental Report. (Division of Reactor Licensing (AEC), Washington, D. C.). 27 Jan 1972. 3p. Dep. NTIS.

17031 (DOCKET-50275-21) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Order Suspending Certain Construction Activities. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Feb 1972. 5p. (DOCKET-50323-19). Dep. NTIS.

17032 (DOCKET-50280-66) SURRY POWER STATION, UNITS 1 AND 2. Areas Examined During Inspection on August 11-13, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 11 Nov 1971. 5p. (DOCKET-50281-64). Dep. NTIS.

Information is presented concerning welding procedures and inspections for piping systems. (D.C.C.)

17033 (DOCKET-50280-67) SURRY POWER STATION, UNIT NO. 1. Findings on Inspection of October 7-8, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 28 Jan 1972. 2p. Dep. NTIS.

Results of inspections are presented concerning electrical and instrumentation installation, containment dome liner corrections, and main coolant loop corrections. (D.C.C.)

17034 (DOCKET-50280-68) SURRY POWER STATION, UNITS 1 AND 2. NORTH ANNA POWER STATION, UNITS 1, 2, 3, AND 4. Specification for Review of Containment Pressure Transient Following a Loss of Coolant Accident. (Virginia Electric and Power Co., Richmond). 26 Jan 1972. 24p. (DOCKET-50281-65; DOCKET-50338-38; DOCKET-50339-36; DOCKET-50404-8; DOCKET-50405-8). Dep. NTIS.

17035 (DOCKET-50280-69) SURRY POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Amendment No. 31. (Virginia Electric and Power Co., Richmond). 1 Feb 1972. 18p. (DOCKET-50281-66). Dep. NTIS.

Performance evaluation for the emergency core cooling system is presented. (D.C.C.)

17036 (DOCKET-50282-49) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Order Extending Provisional Construction Permit Completion Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 7 Feb 1972. 2p. Dep. NTIS.

17037 (DOCKET-50285-55) FORT CALHOUN STATION, UNIT NO. 1. Environmental Radioactivity Samples. (Omaha Public Power District, Nebr.). 20 Jan 1972. 2p. Dep. NTIS.

17038 (DOCKET-50285-57) FORT CALHOUN STATION, UNIT 1. Revised Environmental Report, Supplement No. 1. (Omaha Public Power District, Nebr.). 27 Jan 1972. 152p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Environmental aspects of transmission lines are described. Financial aspects of operation are presented. (D.C.C.)

17039 (DOCKET-50285-58) FORT CALHOUN STATION, UNIT NO. 1. Final Safety Analysis Report, Amendment No. 33. (Omaha Public Power District, Nebr.). 11 Feb 1972. 53p. Dep. NTIS.

Revised design parameters of the Fort Calhoun Power Reactor Unit 1 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17040 (DOCKET-50286-42) INDIAN POINT NUCLEAR GENERATING UNIT 3. Information Provided Pertaining to Safety System Valves. (Division of Compliance (AEC), Newark, N. J. Region I). 21 Jan 1972. 6p. Dep. NTIS.

17041 (DOCKET-50289-47) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. License Applications, Request for Revised Completion Date. (Metropolitan Edison Co., Reading, Pa.). 13 Jan 1972. 3p. Dep. NTIS.

17042 (DOCKET-50289-48) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Containment Building Ring Girder Construction and Repair, Addendum. (Metropolitan Edison Co., Reading Pa.). 19 Jan 1972. 14p. Dep. NTIS.

17043 (DOCKET-50289-49) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment No. 23. (Metropolitan Edison Co., Reading, Pa.). 31 Jan 1972. 204p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operation aspects for the reactor. (D.C.C.)

17044 (DOCKET-50298-26) COOPER NUCLEAR STATION. Order Extending Provisional Construction Permit Completion

Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 26 Jan 1972. 2p. Dep. NTIS.

17045 (DOCKET-50302-34) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Findings on Inspection, December 20-22, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 27 Jan 1972. 1p. Dep. NTIS.

17046 (DOCKET-50302-35) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Schedule for Furnishing Additional Information. (Florida Power Corp., St. Petersburg). 27 Jan 1972. 4p. Dep. NTIS.

17047 (DOCKET-50305-33) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment No. 15. (Wisconsin Public Service Corp., Green Bay). 28 Jan 1972. 244p. Dep. NTIS.

Revised design parameters of the Kewaunee Power Reactor are presented. Additional data on the reactor requested by the Division of Reactor Licensing are included. Meteorological data for the reactor site are also included. (D.C.C.)

17048 (DOCKET-50309-51) MAINE YANKEE ATOMIC POWER STATION. Environmental Report, Supplement No. 1, Volume 1. (Maine Yankee Atomic Power Co., Westboro, Mass.). 27 Jan 1972. 246p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Hydrological, geological, meteorological, and biological data for the reactor site are included. Cost estimates for the reactor are also presented. (D.C.C.)

17049 (DOCKET-50309-52) MAINE YANKEE ATOMIC POWER STATION. Environmental Report, Supplement No. 1, Volume 2. (Maine Yankee Atomic Power Co., Westboro, Mass.). [1971]. 359p. Dep. NTIS.

Biological, hydrological, and meteorological data for the reactor site are presented. Data concerning radiation monitoring of the site during April to December 1970 are also included. (D.C.C.)

17050 (DOCKET-50309-53) MAINE YANKEE ATOMIC POWER STATION. Environmental Report, Supplement No. 1, Volume 3. (Maine Yankee Atomic Power Co., Westboro, Mass.). 1 May 1969. 207p. Dep. NTIS.

Meteorological data for the reactor site are presented. Cost estimates related to reactor operation delays are analyzed. Systems designed to handle the thermal discharges from the reactor are described. (D.C.C.)

17051 (DOCKET-50312-32) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment No. 8. (Sacramento Municipal Utility District, Calif.). 28 Jan 1972. 152p. Dep. NTIS.

Revised design parameters of the Rancho Seco Power Reactor are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17052 (DOCKET-50312-33) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. License Application. (Sacramento Municipal Utility District, Calif.). Nov 1967. 61p. Dep. NTIS.

17053 (DOCKET-50313-37) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment No. 23. (Arkansas Power and Light Co., Little Rock). 21 Jan 1972. 149p. Dep. NTIS.

Revised design parameters of the Arkansas Nuclear One Power Reactor are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17054 (DOCKET-50313-38) ARKANSAS NUCLEAR ONE, UNITS 1 AND 2. Findings on Inspection, November 3-5, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 28 Jan 1972. 3p. (DOCKET-50368-23). Dep. NTIS.

17055 (DOCKET-50315-57) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment No. 19. (Indiana and Michigan Power Co., New York). 7 Feb 1972. 161p. (DOCKET-50316-57). Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the reactors. Included also are additional data on the containment structure requested by the Division of Reactor Licensing. (D.C.C.)

17056 (DOCKET-50317-36) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment No. 17. (Baltimore Gas and Electric Co., Md.). 28 Jan 1971. 471p. (DOCKET-50318-35). Dep. NTIS.

Revised design parameters of the Calvert Cliffs Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactors requested by the Division of Reactor Licensing. (D.C.C.)

17057 (DOCKET-50317-37) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Statement on Environmental Consideration Relating to Issuance of Operating License. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). 20 Jan 1972. 114p. (DOCKET-50318-36). Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

17058 (DOCKET-50321-30) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Findings on Inspection, November 10-12, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 28 Jan 1972. 2p. Dep. NTIS.

17059 (DOCKET-50324-34) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Review of Discharge Canal, December 14, 1971. (North Carolina Dept. of Natural and Economic Resources, Raleigh). 14 Dec 1971. 2p. (DOCKET-50325-34). Dep. NTIS.

17060 (DOCKET-50325-35) BRUNSWICK STEAM ELECTRIC PLANT, UNIT 2. Findings on Inspection November 16-19, 1971. (Division of Compliance (AEC), Atlanta, Ga. Region II). 28 Jan 1972. 2p. Dep. NTIS.

17061 (DOCKET-50333-38) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment No. 4. (Power Authority of the State of New York). 9 Feb 1972. 298p. Dep. NTIS.

Revised design parameters of the James A. Fitzpatrick Power Reactor are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17062 (DOCKET-50335-25) HUTCHINSON ISLAND PLANT, UNIT NO. 1. Order Suspending Certain Construction Activities. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Feb 1972. 5p. Dep. NTIS.

17063 (DOCKET-50338-39) NORTH ANNA POWER STATION, UNITS 1 AND 2. Order Suspending Certain Construction Activities. (Division of Reactor Licensing (AEC), Washington, D. C.). 4 Feb 1972. 4p. (DOCKET-50339-37). Dep. NTIS.

17064 (DOCKET-50346-25) DAVIS-BESSE NUCLEAR POWER STATION. Request for Determination that Certification Persuant to Federal Water Pollution Control Act is Not Required. (Toledo Edison Co., Ohio. Cleveland Electric Illuminating Co., Ohio). 27 Jan 1972. 67p. Dep. NTIS.

Additional information concerning thermal discharges from the reactor is presented. (D.C.C.)

17065 (DOCKET-50348-35) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Farley Plant Will Not Adversely Effect the Interest of Florida. (Alabama Power Co., Birmingham). 17 Jan 1972. 2p. (DOCKET-50364-29). Dep. NTIS.

17066 (DOCKET-50358-31) WM. H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Environmental Report, Supplement No. 3. (Cincinnati Gas and Electric Co., Ohio). 31 Jan 1972. 62p. Dep. NTIS.

Information is presented concerning the effects of reactor operations on the environment. Additional data on the reactor site are included. (D.C.C.)

17067 (DOCKET-50366-22) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Preliminary Safety Analysis Report, Amendment No. 14. (Georgia Power Co., Atlanta). 25 Jan 1972. 6p. Dep. NTIS.

Revised information is presented concerning the group insertion of control rods. (D.C.C.)

17068 (DOCKET-50376-25) AGUIRRE NUCLEAR PLANT, UNIT NO. 1. Preliminary Safety Analysis Report, Amendment No. 13. (Puerto Rico Water Resources Authority, San Juan). 22 Dec 1971. 240p. Dep. NTIS.

Estimated costs for the Aguirre Power Reactor Unit 1 are presented. Financial data on the owners are also included. (D.C.C.)

17069 (DOCKET-50382-16) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment No. 10. (Louisiana Power and Light Co., New Orleans). 4 Feb 1972. 46p. Dep. NTIS.

Revised and additional data are presented concerning the population density near the reactor site. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17070 (DOCKET-50390-8) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment No. 2. (Tennessee Valley Authority, Chattanooga). 21 Jan 1972. 278p. (DOCKET-50391-8). Dep. NTIS.

Revised design parameters of the Watts Bar Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactors requested by the Division of Reactor Licensing. (D.C.C.)

17071 (DOCKET-50390-9) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 3. (Tennessee Valley Authority, Chattanooga). 8 Feb 1972. 333p. (DOCKET-50391-9). Dep. NTIS.

Revised and additional data are presented concerning design requirements, personnel, radioactive waste disposal, reactor site, containment structure, and auxiliary systems. Included also are data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

17072 (DOCKET-50395-14) VIRGIL C. SUMMER NUCLEAR STATION. Environmental Report, Supplement. (South Carolina Electric and Gas Co., Columbia). 25 Jan 1972. 306p. Dep. NTIS.

Cost estimates for the reactor are presented. The effects of transmission lines on the environment are discussed. Radioactive effluents under accident conditions in the reactor are analyzed Biological data for the reactor site are included. (D.C.C.)

17073 (DOCKET-50397-11) HANFORD NO. 2 NUCLEAR POWER PLANT. Issuance of Proposed License Will Not Create a Situation Inconsistent With Antitrust Laws. (Department of Justice, Washington, D. C. Antitrust Div.). 24 Jan 1972. 4p. Dep. NTIS.

17074 (FIND-50373(12-71)) FIND: LA SALLE COUNTY STATION, UNITS 1 AND 2. Revision 1. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 17 Dec 1971. 10p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

17075 (FRNC-CONF-14) ORGANIZATION OF RADIOPROTECTION IN THE EDF NUCLEAR POWER PLANTS. Beau, P.; Martin, J. J. (Electricite de France, Paris). 1971. 12p. (In French). (CONF-710444-4). Dep. NTIS (U. S. Sales Only).

From International conference on chemical sciences; Paris, France (20 Apr 1971).

Environmental control studies by the EDF began in 1958 at the Chinon site. Such controls are reviewed for the four nuclear plant sites currently being used by the EDF. Control methods, better adapted for the future with regards to the risk presented by these plants and to the industrial nature of these installations, are presented. External controls relate to periodic systematic sampling or release measurements. The monitoring at release points (except in the case of an accidental release) is the only efficient method of control. Measurements made from a moving vehicle seem to be more efficient for monitoring the environment and are indispensable in the case of an accidental release or the release of volatile products. (France)

17076 (HEDL-TME-71-168) HERMES: A DIGITAL COMPUTER CODE FOR ESTIMATING REGIONAL RADIOLOGICAL EFFECTS FROM THE NUCLEAR POWER INDUSTRY. Fletcher, J. F.; Dotson, W. L. (comps.) (Hanford Engineering Development Lab., Richland, Wash.). Dec 1971. Contract AT(45-1)-2170. 781p. Dep. NTIS.

A computer model was developed to estimate the release of radionuclides to the environment, and the resultant population dose, within a geographical region as a result of the operation of nuclear facilities within that region. The computer model developed is designated as HERMES (Hanford Engineering Regional Model for Environmental Study). The HERMES model is designed to calculate radionuclide release and radiation dose occurring within a study area in a given year. While cumulative radionuclide release as such is not considered, the accumulated buildup and deposition of key radionuclides is "back-calculated" for a five-to-ten-year period for use in dose calculations. The initial development of the HERMES model was based on a study of the region comprising the Upper Mississippi and Lower Missouri River basins, excluding the Chicago metropolitan area. To estimate the effects on dose in the study area caused by air transport of radionuclides from adjacent regions, an "air envelope" some 200 miles in width was included around the study area. Considerations in the study included the operation of 400,000 MW generating capacity (nuclear and fossil) at 185 separate sites, and reprocessing plants at 9 sites. The HERMES model was designed and developed in modular form. Its component computer codes describe the events relating electric energy generation to the resultant radiation dose to the populace. These codes are designed to be used sequentially, but may be used individually to study a given aspect of the events leading to dose. The component codes of the HERMES model are described, and their design and intended use are discussed. The general philosophy of operation of each code is discussed. Appendices give detailed listings and supporting data to assist in operation of the codes. 153 references. (auth)

17077 (ORNL-TM-3645) NUCLEAR PIPING DESIGN. (Oak Ridge National Lab., Tenn. Teledyne Materials Research [Co.], Waltham, Mass.). Feb 1972. Contract W-7405-eng-26; Subcontract 3059. 211p. Dep. NTIS.

The design of piping systems to comply with the rules for Class-1 piping stipulated in the ANSI Standard Code for Pressure Piping B31.7, Nuclear Power Piping, and in Section III, Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code is discussed. The rules are explained where clarification is needed, and methods of analysis for pressure, thermal, cyclic, and earthquake loads are presented in detail. Guidance in the preparation of the design specification is also presented. (105 references) (auth)

17078 (WASH-1516(Dr.)) ELK RIVER REACTOR DISMANTLING. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Dec 1971. 43p. Dep. NTIS.

The environmental impact of an administrative action for the dismantling of the Elk River Reactor (ERR) is analyzed. A radioactivity inventory indicates that less than 10,000 curies remain at the site, consisting of fixed radioactivity in various reactor components and shielding material. Confinement capability will be maintained until the removal of the radioactive materials from the reactor building is completed and appropriate measures will be taken to preclude the spread of radioactivity so that the dismantling operation will not pose any adverse effect on the environment or undue danger to the public health and safety. All contaminated materials resulting from the dismantling will be disposed of at AEC approved burial grounds which are outside the State of Minnesota. Shipments will conform with the requirements of all applicable standards and regulations. Non-contaminated material will be disposed of as normal waste at a local site. (auth)

17079 THERMAL-HYDRAULIC STUDY: ARKANSAS COOLING RESERVOIR. Riesbol, Herbert S. (Bechtel Inc., San Francisco); Anderson, James B.; Wend, Fred H.; Holmes, Harlan T. J. Power Div., Amer. Soc. Civil Eng.; 97: No. PO1, 93-113(Jan 1971). (CONF-700121-2).

From National water resources engineering meeting; Menphis, Tenn. (26 Jan 1970).

The results are presented of the analytical and thermal-hydraulic model investigations that were carried out to determine whether the plant heat load from an 850-MW nuclear power plant could be dissipated in Dardanelle Reservoir under the criteria and limitations prescribed by the Arkansas Pollution Control Commission. The plant, called Arkansas Nuclear One, is being constructed on a peninsula extending into Dardanelle Reservoir. The cooling water intake will be located on the east shore of the peninsula. After passing through the plant condenser the cooling water will be conveyed through a canal and discharged into a cove on the southwestern shore of the peninsula, where it enters the main body of the reservoir. Arkansas Nuclear One requires 1,700 cfs of circulating water with a maximum water temperature rise of 15°F as it passes through the condenser. The imposed heat load of 137.5×10^9 Btu per day will be dissipated in the lower basin of the Dardanelle Reservoir. 9 references. (auth)

17080 CRITIQUE OF THE AEC'S INTERIM CRITERIA FOR EMERGENCY CORE-COOLING SYSTEMS. Ford, Daniel F.; Kendall, Harry W.; MacKenzie, James J. Nucl. News; 15: No. 1, 28-35(Jan 1972).

Several basic criticisms of the U. S. AEC policy statement setting performance standards for emergency core-cooling systems for water cooled reactors are presented. Deficiencies in the computer codes used to analyze the performance of emergency core cooling systems are discussed. (H.D.R.)

17081 RECOMMENDATIONS TO UTILITIES FOR IMPROVING UTILITY-PUBLIC COMMUNICATIONS CONCERNING NUCLEAR POWER. Seeley, Gilbert Thomas. Lafayette, Ind.; Purdue Univ. (1971). 114p. University Microfilms Order No. 72-1952.

Thesis.

A list of recommended strategies and tactics for improving utility-public communications concerning nuclear power is presented. These recommendations suggest how to effectively prepare and present messages to communicate with critics of nuclear power and with the general public. They also suggest efficient channels for the communication effort. The foundation

for these recommendations comes from two sources: the findings of other investigators reported in attitude change literature, and the results of a survey conducted to learn people's attitudes toward nuclear power. The survey was designed to determine how attitudes toward nuclear power compare between a group of concerned citizens and a random sample of the public. Also investigated were some of these people's knowledge of power and their evaluations of possible sources of information on nuclear power. The survey was designed to obtain information necessary to select appropriate communication strategies from those reviewed in the literature. Such selection often depends on whether certain audience characteristics exist. The pertinent characteristics include audience attitudes relative to the position advocated by a communication, intelligence, and knowledge of the subject matter. (Diss. Abstr. Int., B)

Propulsion and Auxiliary Power Reactors

17082 (AED-CONF-71-100-17) INCORE THERMIONIC REACTOR ITR. Pruschek, R. (Internationale Atomreaktorbau G.m.b.H., Bensberg (West Germany)); Gross, F.; Stehle, H.; Fassbender, J.; Hoecker, K. H.; Oldekop, W. May 1971. 23p. (CONF-710901-521). Dep. NTIS (U. S. Sales Only).

From fourth international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

The goals of the Incore Thermionic Reactor (ITR) program are to develop, construct, and test a power source which utilizes incore thermionic diodes for direct conversion of heat to electricity. The initial phase of the program is to build and test a 20 kW(e) reactor. The reactor and test facility are described, and some potential space power applications for an ITR are discussed. 23 references. (H.D.R.)

17083 (BNL-50321) ROTATING FLUIDIZED BED REACTOR FOR SPACE NUCLEAR PROPULSION. Annual Report: Design Studies and Experimental Results, June 1970-June 1971. Hendrie, J. M.; Hoffman, K. C.; Isler, R. J.; Lindauer, G. C.; Ludewig, H.; Manning, A. J.; Raseman, C. J. (Brookhaven National Lab., Upton, N. Y.). Aug 1971. 82p. Dep. NTIS.

The rotating fluidized bed reactor concept is being investigated for possible application in nuclear propulsion systems. Physics calculations show ^{233}U to be superior to ^{235}U as a fuel for a cavity reactor of this type. Preliminary estimates of the effect of hydrogen in the reactor, reflector material, and power peaking are given. A preliminary engineering analysis has been made for ^{235}U- and ^{233}U-fueled systems. An evaluation of the parameters affecting the design of the system is given, along with the thrust-to-weight ratios. The experimental equipment is described, as are the special photographic techniques and procedures. Characteristics of the fluidized bed and experimental results are given, including photographic evidence of bed fluidization at high rotational velocities. 11 references. (auth)

17084 IEEE CONFERENCE RECORD OF 1970 THERMIONIC CONVERSION SPECIALIST CONFERENCE. Papers Presented at the Ninth Annual Conference, Miami Beach, Florida, October 26-29, 1970. 70 C 53-ED. New York; Institute of Electrical and Electronics Engineers, Inc. (1970). 580p. (CONF-701039).

Included are 85 papers on materials, theory, and systems for thermionic power sources. A separate abstract was prepared for each of 84 papers. One paper was previously abstracted for NSA and may be located under CONF-701039 in the Report Number Index. (H.D.R.)

For abstracts of individual papers see: 15078-15114, 15125, 15139, 15140, 15610-15614, 15653, 15654, 15733-15742, 15815-15819, 16117-16120, 16631, 16632, 16664, 17085-17097, 17100, and 17104.

17085 THERMIONIC REACTOR EXPERIMENT DESIGN. Fisher, C. R.; Ellis, W. H.; Merrill, M. H.; Heath, C. A. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 130-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The conceptual design of a thermionic reactor experiment is presented. The experiment is to determine the dynamic and steady-state characteristics of a thermionic reactor. The design description is for a liquid metal-cooled, fast spectrum reactor delivering 100 kW(e) to an external electrical load. Provision is made for replaceable fuel elements with testing beginning with a core composed of non-thermionic, driver fuel elements and, progressing to an all-thermionic fuel element core. The conceptual design is based upon use of the Fast Reactor Core Test Facility at Los Alamos, New Mexico. The design includes building modifications as well as new equipment including liquid metal coolant, containment and environmental, fuel handling, and instrumentation systems. The equipment design is applicable to other facilities that might be used other than the FRCTF. 7 references. (auth)

17086 THERMIONIC REACTOR EXPERIMENT: A CONCEPTUAL DESIGN. Gilliland, D. L. (General Electric Co., Pleasanton, Calif.). Contract No. AT(04-3)-771. pp 140-4 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The conceptual design for a thermionic reactor experiment (TREX) is presented. The TREX is to explore and evaluate the dynamic and steady-state operating characteristics of a 100 kW(e), ^{235}U fueled fast spectrum thermionic reactor core. The conceptual design features of the reactor, core, vessel, thermionic fuel element and the reflector control system are summarized. In addition, the liquid metal coolant and inert gas systems, the method for fuel element replacement and associated equipment, and instrumentation and control systems are described. The test facility requirements and a possible facility arrangement are also discussed. (auth)

17087 25-kWe THERMIONIC POWER SYSTEM FOR SPACE-BASE APPLICATION. Gietzen, A. J.; Fisher, C. R.; Homeyer, W. G. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 145-50 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

An in-core thermionic power system to provide 25 kW(e) for the Manned Space Station application is described. It employs a reactor with U-ZrH driver fuel elements in addition to thermionic fuel elements. The basic thermionic fuel element is the same as that being built for in-pile test (6F1) except for the emitter clad thickness which has been doubled for long lifetime with a minimum of development. The nuclear radiation shield is in a shaped "4π" configuration. The heat rejection and power conditioning subsystems are similar to those of a 100 kW(e) system design except for size. The 25 kW(e) system is designed for 1000°F reactor coolant outlet temperature and thermionic electrode performance of 3.5 W/cm^2 at beginning of life. Performance figures for the power system are given. (auth)

17088 100-kWe THERMIONIC POWER SYSTEM FOR SPACE-BASE APPLICATION. Gietzen, A. J. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 151-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

An in-core thermionic power system to provide 100 kW net electric power and to meet the shielding requirements of a manned spacecraft is described. The reactor core is composed of thermionic fuel elements. The gross power capability of the reactor is considerably greater than required for the 100 kW(e) net system output, allowing derated thermionic conditions as well as providing redundant power capability to compensate for failures. The average power and current densities are 3 W/cm^2 and 3.5 amp/cm^2. The maximum emitter temperature is 1900°K. The electrical output from each pair of fuel elements is processed from ~10 volts dc to ~200 volts dc for transmission to the spacecraft. Waste heat is removed from the reactor by pumped NaK loops and radiated from heat pipe panels arranged in a cylindrical structure. Factors to be considered in integrating the power system with the Space Base are discussed. (auth)

17089 CONCEPTUAL DESIGN OF A NUCLEAR THERMIONIC POWER PLANT FOR THE SPACE-BASE. Sawyer, C. D. (General Electric Co., Pleasanton, Calif.). Contract AT(04-3)-771. pp 159-63 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The results of conceptual design studies aimed at providing a nominally 100 kW(e) station power source for the Space Base by using an in-core nuclear thermionic power plant are presented. Based on a set of ground rules described, a reference power plant was established. The overall plant efficiency is 8.0%, radiator area requirements are 1300 ft^2, and the initial launch weight is 60,000 lbs., of which 42,000 lbs is shielding. Part of the shield

is designed to be permanently attached to the base, so a replacement launch would weigh about 35,000 lbs. (auth)

17090 THERMIONIC REACTOR SYSTEMS FOR ELECTRIC PROPULSION. Mondt, Jack F. (Jet Propulsion Lab., Pasadena, Calif.). Contract No. NAS 7-100. pp 164-8 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970)

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Electric propulsion system spacecraft studies are performed to direct technology, to provide specifications for components and to obtain performance data for mission planning. Study results show that, from a systematic performance standpoint, large L/D (15 to 20), side thrust, 75-kW(e) thermionic reactor spacecraft are desirable for unmanned missions to Jupiter, Saturn, Uranus, and Neptune. The calculated specific weight for the referenced 75-kW(e) thermionic reactor electric propulsion system is 71.5 lb/kW(e). If the thermionic reactor voltage is increased from 13 to 39 Vdc, this propulsion system weight is reduced 12%. Increasing the radiator temperature from 675°C to 815°C reduces propulsion system weight 7%. (auth)

17091 OUT-OF-CORE THERMIONIC POWER PLANT FOR MANNED SPACE STATION. Schock, A.; Abbate, M. J.; Eisen, C. L. (Fairchild Hiller Corp., Farmingdale, N. Y.). pp 169-78 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

An out-of-core design for a reactor-heated thermionic power plant is described. The design strives for maximum redundancy, to permit continued operation after local failures of various components. To illustrate the concept, a specific power plant design for a manned space station is presented. In order to meet the long mission-life requirement, the design permits periodic replacement of critical system components. Sizes and weights are given, both for the replaceable items, and for the permanent parts of the power plant, which include a man-rated, isotropic 4π-shield. 15 references. (auth)

17092 DYNAMIC BEHAVIOR OF A DRIVER INCORE THERMIONIC REACTOR. Dagbjartsson, S.; Siegel, K. (Univ., Stuttgart). pp 251-6 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

With respect to its dynamic behavior, the partial incore thermionic reactor ITR takes its place between a conventional reactor and a full thermionic reactor. The driver zone, which contains 400 SNAP-like fuel elements with prompt negative temperature coefficients, gives the reactor an inherent stability. On the other side the electrical behavior of the reactor is characterized by the 133 thermionic converters. They are arranged in 19 flash-light thermionic fuel elements at the center of the core and will be operated at approximately 5 W_{el}/cm^2 and 1800°K emitter temperature. The theoretical model for the dynamic study of the system takes in account the heat conduction from the fuel holes in the emitter body and the heat transfer to the collector. The energy transfer processes from emitter to collector are simulated by the computer program SIMCON. In this study, limited to the ground-test system, the cooling loops are simulated by conventional loop with Na–Na and Na–air heat exchangers for the primary and secondary loops, respectively. For the neutron kinetics the prompt-jump approximation is used and region-dependent temperature coefficients are taken in account. The results of the calculations show that the reactor will have a good stability. Disturbances in the electrical loop will hardly influence the reactivity because of the damping effect of the driver zone and the small feedback coefficients of the thermionic zone. (auth)

17093 SPLIT-CORE HEAT PIPE REACTOR CONCEPT FOR AN OUT-OF-CORE THERMIONIC POWER SYSTEM. Niederauer, George; Lantz, Edward (Lewis Research Center, Cleveland). pp 257-61 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The design and operation of small ^{235}UC- and ^{233}UC-fueled cores with axial heat pipes for a 350 kW(e) out-of-core thermionic power system was investigated. A split in the core at midplane is used for reactivity control. Each half core is built up from modules, each of which consists of a fuel element with a central heat pipe that extends beyond the axial reflector. With 1cm-diameter heat pipes a typical ^{235}U core has a 30 cm diameter and contains 123 kg of ^{235}U and a typical ^{233}U core has a 24 cm diameter and contains 55 kg of ^{233}U. The physics of the design concept are presented for both ^{235}UC and ^{233}UC systems. A study of the startup dynamics of the reactor and heat pipes shows that ramp reactivity inputs should be limited to less than 2 cents/sec for the ^{233}U reactor and less than 8 cents/sec for the ^{235}U reactor. (11 references) (auth)

17094 REACTOR PHYSICS STUDIES FOR THE THERMIONIC REACTOR EXPERIMENT. Hill, P. R.; Louie, W. N. (General Electric Co., Pleasanton, Calif.). Contract No. AT(04-3)-771. pp 262-7 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Parametric criticality studies which evaluate the influence of thermionic fuel element and reactor core design variations are presented. Designs which can fulfill criticality requirements are identified. Various reactivity coefficients for a typical design are presented and the corresponding power coefficients of the reactor are derived. The influence of reactor design on the power coefficient is discussed. Evaluations of control system worth are also presented. Comparisons of one and two dimensional transport calculations are presented and calibrations of the transport calculations and nuclear data against critical experiment data are made. 10 references. (auth)

17095 ANALYSIS OF THERMIONIC REACTOR EXPERIMENT. I. NUCLEAR. Hackney, M. R. (Gulf General Atomic Co., San Diego, Calif.); Sargis, D. A. Contract AT(04-3)-167. pp 274-9 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The Thermionic Reactor Experiment was designed to test a BeO reflected fast spectrum, liquid metal-cooled reactor, containing flashlight, thermionic fuel elements. The nuclear analyses performed for this core include detailed power distributions, control drum worth, fast damage flux, and temperature coefficients. Of primary interest are the temperature coefficients, which include the Doppler coefficients and expansion coefficients. Previous studies have shown that the prompt temperature coefficients of reactivity for a small, fast system of this type are quite small. Since these coefficients are of great importance in the safety analyses, a detailed study of both the prompt and delayed temperature coefficients was made. A two-dimensional transport perturbation theory code was developed for the purpose of evaluating these coefficients. This code utilizes scalar neutron fluxes and currents as computed by a two-dimensional discrete ordinates transport code, and computes the change in inverse multiplication factor $[\Delta(1/k)]$ due to various perturbations. Results of these analyses confirm the small negative prompt temperature coefficient, which includes a small fuel Doppler effect, a negative tungsten Doppler effect and a small positive fuel expansion effect. The niobium Doppler coefficient and the coolant and structural expansion coefficients, although delayed with respect to the fuel coefficients, are important because they are significantly larger in magnitude than the prompt coefficients. (auth)

17096 THERMIONIC REACTOR POWER PLANT FOR SPACE BASE. Schock, A.; Abbate, M. J.; Eisen, C. L. (Fairchild Hiller Corp., Farmingdale, N. Y.). Contract AT(30-1)-3873. pp 361-7 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

A thermionic reactor power plant for long-term space base operation is described. A basic feature of the design is the ability to interchange reactor cores in a simple way, to achieve long life. The replacement package is kept light and relatively compact by limiting it to the reactor core and a heat-pipe cooling system. The fixed structure, used throughout the mission, consists of the radiation shields, reflectors, and reactor control system, and comprises 90% of the plant mass. The performance, size, and weights of a 100 kW(e) power plant are given. (auth)

17097 120-kWe THERMIONIC REACTOR ION PROPULSION SPACECRAFT FOR THE HALLEY COMET RENDEZVOUS MISsion. Prickett, W. Z. (General Electric Co., Valley Forge, Pa.). Contract NAS 7-100. pp 368-75 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

Thermionic reactor power systems are integrated into a large unmapped electric propulsion spacecraft. Both 120 kW(e) (Pe)

^{235}U externally fueled and ^{233}U flashlight reactor power plants are investigated. The reference mission is the 940 day Halley Comet rendezvous, requiring an April 1983 launch. The reference launch vehicle for direct injection of the thermionic spacecraft to earth escape is the Titan Centaur class. The main radiator is located on the reactor side of the shield. This eliminates coolant pipe penetrations through the shield, minimizes their length, and separates the high temperature (1400°F) components from the low temperature (200°F) components. The initial calculated propulsion system specific weight for the 120 kW(e) externally fueled reactor/spacecraft is 67.5 lbs. All spacecraft component designs, except for the thermionic reactor, are based on present day technology. 8 references. (auth)

17098 UNIQUE METAL HYDRIDE CONTROLLED REACTOR. Magladry, Robert E. (to Teledyne, Inc.). U. S. Patent 3,627,633. 14 Dec 1971. Filed 6 Nov 1967.

Metal hydride controlled nuclear reactors are described which involve thermally isolated, first and second sealed containers carrying metal hydride, one including nuclear fuel material and the other acting as a hydrogen reservoir. Means are provided to facilitate reactor startup. In different embodiments they take the form of electrical heaters for the core and reservoir elements, chemical heaters for these elements and an additional source of hydrogen for these elements. Hydrogen dissociation is utilized to perform a cooling function during atmospheric reentry of reactors in spatial applications. (auth)

Control and Instrumentation

17099 (EUR-4560) COLLISION TESTS WITH SHIP MODELS. (European Atomic Energy Community. FIAT, Turin (Italy). Sezione Energia Nucleare. ANSALDO S.p.A., Genoa (Italy)). Nov 1971. 128p. Dep. NTIS (U. S. Sales Only). EUR F.Fr. 20.55.

The development of a nuclear-powered tanker included the execution of a series of collision tests with models for the purpose of evaluating the effectiveness of various types of ship-side structures designed to protect the reactor space in the event of collision. During the initial stage of this part of the programme it became clear that a number of technical problems relating to the carrying out of such tests had to be resolved before any conclusive information could be derived from them. A series of 14 collision tests were performed between May 1963 and July 1970; the conditions for each test were specified only after analysis of the results obtained with the previous one, only one particular parameter being changed at a time. A set of two steel models on a scale of 1:15, consisting of a ship's bow-section and a section representing the collision protection structures in the side of the reactor compartment of a nuclear ship, were constructed for each experiment. An account of the general criteria adopted for these experiments and the particular considerations underlying the parameter variations are described. A detailed description of the results is given and a tentative correlation with the full-scale example elaborated. (auth)

17100 DYNAMICS AND CONTROL OF THE THERMIONIC REACTOR EXPERIMENT. Peck, C. B.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif.). Contract AT(04-3)-771. pp 268-73 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The open loop dynamic characteristics of a small, fast spectrum, thermionic reactor are reviewed. The influences of weak reactivity feedback mechanisms, the large number of controllable variables, and the novel electron cooling heat transfer mechanism on the design of the reactor control system are discussed. The unique features of the thermionic reactor are recognized in defining nuclear, hydraulic, and electrical control subsystems. Nuclear control is primarily manual, but may include a provision for automatic shim control of the reactor thermal power. Hydraulic control is manual with programmed scram response. Electrical control of TFE currents is accomplished automatically within power regulation modules, which service pairs of thermionic fuel elements, and control current to balance electron cooling heat removal and thermal power generation. These control provisions enable TREX to be operated as a conventional nuclear plant and offer many reliability advantages which are discussed. The results of non-linear transient simulation studies on the closed loop plant are discussed. Control laws are defined which permit the plant to achieve desirable response characteristics during startup, reactor maneuvering, shutdown and scram. In addition, the control system is shown to be effective throughout the transition from a non-thermionic core to a full thermionic core. (auth)

Operation and Economics

17101 (DOCKET-50238-88) N. S. SAVANNAH. Operations Report, April 1-August 23, 1971. (Maritime Administration, Washington, D. C.). 3 Feb 1972. 8p. Dep. NTIS.

17102 NUCLEAR POWER SHIP PROPULSION: ECONOMY QUESTIONS. Gietzelt, M. (Technische Univ., Hanover). Schiff Hafen; 23: No. 1, 35-42(1971). (In German).

An analysis is given of the expected development concerning the expenditure items for various driving systems. The analysis concerns the following items: investment, operating expenditures, insurance, personnel, repair and maintenance, and others. The application of nuclear propulsion for various types of merchant ships (tanker, container ships) is investigated, based upon considerations as to maximum profitability. (INIS)

Safety

17103 (LA-4853) NUCLEAR SAFETY OF AN AIRBORNE THERMAL REACTOR. Status Report of the Reactor Criticality Analysis Program to December 1, 1971. Vigil, J. C.; Carmichael, B. M.; Best, G. H. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 3p. Dep. NTIS.

The Air Force Weapons Laboratory (AFWL) is evaluating various aspects of the safety of mobile nuclear reactors, particularly airborne reactors. AFWL is sponsoring tests to assist in the development of containment vessels which will survive impact deformations without rupturing or leaking, to determine the deformation of the reactor cores due to impact and to evaluate engineered safety features under impact. The Reactor Theory Group of the Los Alamos Scientific Laboratory (LASL) is supporting this work by assessing the nuclear criticality and other reactor parameters for both normal and deformed core configurations. It has been proposed that small spheres of diluent-poison material be placed around the periphery of the reflector in the gas-cooled, water-moderated thermal reactor concept to serve as a shutdown mechanism in case of a core meltdown. Investigations of the effect of the diluent-poison on the normal configuration are described. An evaluation of the effect of complete compaction of the core is also presented. (auth)

17104 ANALYSIS OF THE THERMIONIC REACTOR EXPERIMENT. II. SAFETY AND DYNAMICS. Heath, C. A. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 280-4 of IEEE Conference Record of 1970 Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1970).

From Thermionic conversion specialist conference; Miami Beach, Fla. (26 Oct 1970). See CONF-701039.

The largest reactivity coefficients in the thermionic reactor are associated with the liquid metal coolant and core structural components whose temperature is closely coupled to that of the coolant. The large capacity of the liquid metal coolant system and the long loop delay times imposed by the placement of equipment in the FRCTF will produce dynamic behavior which is not characteristic of the flight system. However, it is shown that characteristics of the reactor alone can be determined in TREX despite the presence of the large coolant loop system. Specific examples of safety constraints on the operation of the automatic control system of the thermionic reactor are discussed. It is shown that high power level scrams or restrictions on the rate of reactivity insertion can interfere with the desired operation of a control system responding to a simulated change in spacecraft power demand. The implications of subjecting the reactor to simulated spacecraft load requirements while satisfying facility safety criteria are considered. 8 references. (auth)

Process Heat and Desalination Reactors

17105 (INIS-mf-113) DESALINATION: AN ANNOTATED BIBLIOGRAPHY, 1968-1970. Volume 1, Number 2. Malwad, N. M. (comp.) (Bhabha Atomic Research Centre, Bombay (India)). 1971. 126p. INIS.

The subject-scope of the bibliography encompasses various processes of desalination in general and nuclear desalination in particular, their comparative evaluation studies, the economics, and the state of the art in various countries. It is based on Nuclear Science Abstracts 1968-1970 and includes 160 documents that are available in the Library and Technical Information Section, Bhabha Atomic Research Centre, Trombay, Bombay, (India). The entries are grouped in broad subject categories and arranged alphabetically according to the author's name within each category. Under each entry, the minimum required bibliographic data such as the

first two authors, title, sub-title, report-number, availability code, bibliographic citation, year of publication, abstract and the source reference are provided. Cumulative author, report number and subject indexes are provided. (INIS)

Operation and Economics

17106 (RT/GEN-(71)2) PREDICTED PROGRAM FOR A DESALTING REACTOR. Berardinelli, L.; Cesari, F.; De Luccia, R.; Stampone, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Mar 1971. 71p. (In Italian). Dep. NTIS (U. S. Sales Only).

Data used to define the time-schedule for the construction of a nuclear reactor designed for sea-water desalting purposes are presented. The schedule covers the time from the beginning of final design to the plant construction end including the first period of normal operation. 5 references. (auth)

Research and Test Reactors

17107 (AECL-4061) STATIC MEASUREMENTS IN COUPLED CORES IN THE ZED-2 REACTOR. McDonnell, F. R. N.; Okazaki, A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov 1971. 57p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Critical heights, flux distributions and neutron spectrum parameters were measured for heavy-water-moderated coupled cores of 3.25 cm diameter natural-uranium metal rods. The cores consisted of 112 rods at a 15 cm square lattice pitch. Measurements were made for separations of up to 90 cm between the two halves of the cores. The reactivity effect of an absorber (Co wire) in the cores was also measured. Calculations made with the heterogeneous code, MICRETE-4, are in good agreement with the measurements. 8 references. (auth)

17108 (ANCR-1008) METHODS USED FOR PHYSICS ANALYSIS OF THE POWER BURST FACILITY AND COMPUTED RESULTS FOR THE DESIGN CORE. Rushton, B. L.; Carpenter, W. R. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jul 1971. Contract AT(10-1)-1375. 116p. Dep. NTIS.

The reactor core for the Power Burst Facility (PBF) was designed to allow testing nuclear fuels to melting and vaporization without endangering the driver core. The core design, therefore, is such that power peaking relative to the driver core power is provided in a test space located in the center of the core. Reactor physics calculational techniques and results for the initial core design are described. Most aspects of the overall reactor physics model were tested by comparing with experiment or by using more than one calculational approach. The verification of methods is presented and shows the adequacy of the model for PBF design purposes. (30 references) (auth)

17109 (ANCR-1016) NUCLEAR TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1971. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971. Contract AT(10-1)-1375. 556p. Dep. NTIS.

Research and development progress is reported in eight sections on neutron interactions, nuclear properties, materials, test reactors, experimental facilities, radiometric methods, and applied mathematics. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 14655, 15345, 15840, 16542, 16566, 16862, 17110, and 17126.

17110 (ANCR-1016, pp 159-249) TEST REACTOR OPERATIONS SUPPORT. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

ADVANCED TEST REACTOR — physics of, effects of in-pile tube on, (E)
— in-pile tube in, γ heating in, (E)
— in-pile loops in, temperature reactivity effects of, (E)
— experimental facility for, reactivity effects of combined beam tube-rabbit tube, (E)
— operation of, expanded data system for monitoring
— reactivity meter for, testing of improved
— reactivity meter for, design and theory of improved
— fuel elements for, clad thickness measurements on
— core components for, radiation effects on structural, (E)
— fuel elements for, performance of startup, (E)
— fuel element failure in, performance of delayed neutron monitor for detection of, (E)
ALUMINUM ALLOYS — Al-U, weight changes in fuel powders of, effects of storage time on, (E)
ALUMINUM — radiation effects on mechanical properties of, neutron, (E)
BERYLLIUM — radiation effects on mechanical properties of, neutron, (E)
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— fuel elements for, oxide film thickness on irradiated, (E)
— reactivity power coefficients in, (E)
— reactivity temperature coefficient in, measurement of bulk water
HAFNIUM — radiation effects on mechanical properties of, neutron, (E)
MATERIALS TESTING REACTOR — noise in Phoenix core of, cross power spectral density of, (E)
NEUTRONS — effects on mechanical properties of aluminum, beryllium, and hafnium, (E)
PERSONNEL — training program for reactor operators at NRTS
RADIATION MONITORING — instrumentation reliability and performance for, study program for
REACTOR FUEL ELEMENTS — corrosion film thickness on, eddy current sensor measurement of oxide (H.D.R.)

17111 (BNWL-1603) MEASUREMENT AND ANALYTICAL CORRELATION OF NEUTRONIC PARAMETERS FOR A WATER MODERATED LATTICE CONTAINING UO_2-PuO_2 PARTICULATE FUELS. Newman, Darrell F.; Gordon, Clinton R. (Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1971. Contract AT(45-1)-1830. 91p. Dep. NTIS.

The neutron multiplication factor, k_∞, and relative reaction rates have been measured at room temperature in the Physical Constants Testing Reactor for a water moderated lattice fueled with Zircalloy clad UO_2-PuO_2 fuel rods. The plutonium content in different sets of fuel rods ranged from 0.9 to 2.5 wt % PuO_2 in UO_2. These experiments provide neutronics data for uniform lattices of mixed oxide fuels which contain plutonium oxide distributed throughout the uranium oxide as finite-sized particles. The PuO_2 particle sizes in different sets of fuel rods ranged between zero and 328 microns in diameter. Knowledge of the effect that plutonium particle size has on neutron multiplication is important for the economic utilization of plutonium. An experiment-theory correlation is presented which provides a basis for assessing the adequacy of calculational techniques. (37 references) (auth)

17112 (COO-2117-2) PROGRESS OF THE REACTOR SHARING PROGRAM AT THE UNIVERSITY OF MICHIGAN DURING THE PERIOD OCTOBER 1, 1970-SEPTEMBER 30, 1971. Kerr, W. (Michigan Univ., Ann Arbor. Michigan Memorial Phoenix Project). Dec 1971. Contract AT(11-1)-2117. 8p. Dep. NTIS.

The use of the Ford Nuclear Reactor at the University of Michigan by other colleges and universities is summarized for the period October 1, 1970 to September 30, 1971. The sharing program consisted of providing technical and irradiation services to seven area schools. (H.D.R.)

17113 (EURFNR-926) FEASIBILITY STUDY ON THE FR-3 FAST HIGH-FLUX TEST REACTOR. Fischer, M. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). Translation of report KFK-1356. 594p. Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Physics calculations and design characteristics for the FR-3 reactor are presented. Cost estimates for the test facility are included. (D.C.C.)

17114 NUCLEAR REACTOR AS A SOURCE OF GAMMA RADIATION. Bod, Laszlo; Nemeth, Andras; Varkonyi, Lajos. Energ. Atomtech.; 24: No. 2, 100-4(Feb 1971). (In Hungarian).

During operation of a reactor, much radiation is "wasted." In order to make use of this radiation, studies have been made of potential industrial applications. The studies on industrial applications of γ radiation conducted at the Budapest WWR-C reactor are reviewed. (13 references) (H.D.R.)

Control and Instrumentation

Refer also to abstracts 14758, 15005, and 15006.

17115 (ANCR-1015) ATR EXTENDED BURNUP PROGRAM. Griebenow, M. L. (ed.) (Aerojet Nuclear Co., Idaho Falls, Idaho). Nov 1971. Contract AT(10-1)-1375. 197p. Dep. NTIS.

The objective of the ATR extended burnup program is to minimize the fuel cost per MWd within the constraints provided by the existing fuel element design, and the current inventory and procurement schedule. Fuel element structural considerations currently limit the maximum allowable fuel burnup to 1.5×10^{21} fissions/cc. Scoping calculations indicate that extension of the burnup limit to 1.8×10^{21} fissions/cc and proper blending of standard and graded fuel (7F) elements would minimize fuel costs by allowing the ATR to operate to the reactivity limit in

either balanced or unbalanced mode with the presently envisioned experimental programs. All supportive information relative to the feasibility and safety of operating to 1.8×10^{21} fissions/cc is presented. (auth)

17116 (BNWL–1627) DESTRUCTIVE AND NONDESTRUCTIVE ANALYSIS OF PLUTONIUM FUELS USED IN LATTICE EXPERIMENTS. Stinson, W. P.; Uotinen, V. O. (Battelle Pacific Northwest Labs., Richland, Wash.). Oct 1971. Contract AT(45-1)-1830. 29p. Dep. NTIS.

Plutonium-enriched fuel rods that have been used in zero-power critical experiments under the plutonium utilization program have been reanalyzed and investigated to check and verify their fuel content and composition. It appears that average Pu enrichments reported in the past for these fuels are valid. The reporting of ^{241}Am contents for the fuels, as well as dates for the original chemical separation of Pu for each fuel, and dates for each of the critical experiments are included. This information is needed for accurate calculations of the critical experiments. (3 references) (auth)

17117 (DOCKET-50184–34) NATIONAL BUREAU OF STANDARDS REACTOR. Technical Specifications, Modification of Fuel Element Design. (National Bureau of Standards, Washington, D. C.). 2 Feb 1972. 2p. Dep. NTIS.

17118 (JAPFNR–18) RESEARCH AND DEVELOPMENT OF THE METHOD OF CALCULATION OF CONTROL ROD WORTH BY MONTE CARLO METHOD. INSTRUCTIONS FOR USE OF MONEX-ROD CODE. Nakamura, H. (Fuji Electric Co. Ltd., Tokyo (Japan)). Translation of a Japanese report. 17p. Dep. NTIS (U. S. Sales Only).

MØNEX-RØD has been developed by modifying the geometry routine of the Monte Carlo code MØNEX in which group constants are used as input cross sections. The geometry routine is so written as to be best suited for the analysis of the results of experiments on the control rod in the fast critical assembly. The MØNEX-RØD code is presently written for CDC6600. (auth)

17119 REACTOR NEUTRON FLUX MONITORING WITH IRON FOILS. Bibby, D.M. (National Inst. for Metallurgy, Johannesburg); Rasmussen, S. E. Radiochem. Radioanal. Lett.; 9: No. 1, 1-8(15 Jan 1972).

The use of iron foils for neutron flux monitoring was investigated and shown to be superior to cobalt–aluminium wire monitoring. The activity due to ^{54}Mn produced by a fast neutron reaction in the iron, enables variations in the fast neutron flux to be corrected. (auth)

17120 REACTOR POWER MONITORING BY MEASURING ^{16}N AND ^{17}N IN PRIMARY COOLING WATER. Kimura, Itsuro; Atobe, Kozo; Shibata, Toshikazu. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 4: 34-41(1971).

By measuring the activities of ^{16}N and ^{17}N in the primary cooling water of the Kyoto University Reactor, KUR, the reactor power was monitored avoiding the effect of change of neutron flux distribution during long time operation. The proportionality between the power given by CIC and the counts of ^{16}N or ^{17}N was satisfactory except for ^{16}N counts at the maximum power, 5,000 kW, therefore the system by ^{17}N counting was concluded to be superior to that by ^{16}N. With both power monitors, it was found the power of KUR did not drift during three days in spite of large movement of control rods. The flow rate of the primary cooling water of KUR was also measured by ^{17}N and the result agreed with that obtained with a conventional flow meter. (8 references) (auth)

17121 ANALYSIS OF SHIELDING DESIGN OF TRIGA MARK-II REACTOR: AFTER POWER UPGRADING BY 2.5 FOLDS. Lee, Chang Kun (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 3: No. 4, 185-97(Dec 1971).

Korea's TRIGA Mark-II reactor was designed in the 1950's and was constructed in 1962 for 100 kW thermal output, but it was upgraded to 250 kW in July 1969. Nevertheless, the shield remains unchanged, although the radiation level has increased. The result of computation shows that, with the existing shield, it is safe for the fast neutrons even after the power upgrading by 2.5 times. It is, however, somewhat dangerous for the gamma rays which are comprised of primary and secondary. For the analysis of the reactor shielding design, an attempt is made for the computation toward the horizontal direction. From a theoretical point of view, it can be concluded that some layers of additional shield must be reinforced to the existing concrete in order to be radiologically safe in the reactor hall. (14 references) (auth)

Operation and Economics

17122 (DOCKET-50184–35) NATIONAL BUREAU OF STANDARDS REACTOR. Primary System Heat Exchanger. (National Bureau of Standards, Washington, D. C.). 2 Feb 1972. 1p. Dep. NTIS.

The repair of a leak in the main primary system heat exchanger is described. (D.C.C.)

17123 (DOCKET-50184–36) NATIONAL BUREAU OF STANDARDS REACTOR. Technical Specifications, Change Request. (National Bureau of Standards, Washington, D. C.). 3 Feb 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the scheduling of surveillance tests. (D.C.C.)

17124 (DOCKET-50184–37) NATIONAL BUREAU OF STANDARDS REACTOR. Technical Specifications, Change No. 3. (Division of Reactor Licensing (AEC), Washington, D. C.). 14 Feb 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning the use of modified fuel elements. (D.C.C.)

17125 (KFK–742) OPERATING REPORT FOR THE RESEARCH REACTOR FR2 FOR THE YEAR 1968. Steiger, Werner (Kernforschungszentrum, Karlsruhe (West Germany)). May 1971. 127p. (In German). Dep. NTIS (U. S. Sales Only).

In 1968, the research reactor FR2 was operated largely along the lines of the schedule for 1968 drawn up in December 1967. On January 4, 1968, 12:32 p.m., full reactor power was reached again after repair of the leak of the core tank discovered on November 17, 1967. The schedule provided for 10 operations phases of 5 weeks each and one shutdown phase of 3 weeks. Reactor power for all operations phases was fixed at 44 MW. Within the ten operations phases of 35 days each, the reactor was run on the average for 30 days and shut down for 5 days, which corresponds to a maximum possible utilization of 86%. The rate actually attained was 82%. The experiments were run without major interruptions of reactor operation. There has been a definitive increase in utilization of the experimental facilities as against the previous year. The number of disturbances resulting in reactor scram has increased in accordance with the number of systems connected with the scram system. There were three interruptions, each lasting for the period of one reactor operations phase, which occurred in the low temperature irradiation facility because of repair work on the expansion machine. (6 references) (auth)

Safety and Siting

17126 (ANCR–1016, pp 379-400) EXPERIMENTAL FACILITIES. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1971.

In Nuclear Technology Division annual progress report for period ending June 30, 1971.

CALIFORNIUM-252 — neutron flux from, subcritical multiplication of, (E)
CRITICAL ASSEMBLIES — startup testing of Split Table Reactor
ENGINEERING TEST REACTOR — rabbit tube facility for, relocation of pneumatic
EXPONENTIAL PILES — neutron flux from californium-252 source in Nuclear Test Gage, multiplication of, (E)
LINEAR ACCELERATORS — sample changer for ORELA, design of radioactive
REACTORS, RESEARCH — neutron spectrum in CFRMF, (E) (H.D.R.)

17127 (EURFNR–925) SUPERHEATED STEAM LOOP FOR FR-2 FOR CONTAMINATION STUDIES (HDK LOOP). Aass, H. L.; Hain, K.; Kramer, W.; Waibel, E.; Zimmermann, A. (Kernforschungszentrum, Karlsruhe (West Germany)). Translation of report KFK–1308. 198p. Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A superheated steam contamination loop intended to help in investigating questions relating to system contamination of a Loffler system characterized by direct admission to the turbine is described. The results of planning for this superheated steam contamination loop are presented which were obtained from the middle of 1967 to the end of 1968 with the assistance of two industrial firms. The emphasis has been laid on the description of the technical implementation of experimental requirements as well as the comprehensive safety investigations. (auth)

17128 (WASH–1514(Dr.)) POWER BURST FACILITY. National Reactor Testing Station, Idaho. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Dec 1971. 76p. Dep. NTIS.

Information concerning the effects of Power Burst Facility operations on the environment is presented. Biological, geological, and hydrological data for the reactor site are included. Radioactive effluents from the reactor are analyzed. Cost-benefit analysis for operating the reactor is presented. 22 references. (D.C.C.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 15144, 15248–15252, 15353, 15570, 15571, 15617, 15622, 15623, 15672, 15673, 15730, 15749, 15752, 15832, and 15839.

17129 (GULF-GA-B-10620) CAPTEM: A COMPUTER CODE FOR THE THERMAL ANALYSIS OF FUEL IRRADIATION CAPSULES. Carosella, D. P.; Chi, H. W.; Del Bene, J. V.; Kearney, D. W. (Gulf General Atomic Co., San Diego, Calif.). Sep 1971. Contracts AT(04-3)-167; AT(04-3)-633. 80p. Dep. NTIS.

The CAPTEM code is used for the post-irradiation thermal analysis of fuel capsules. Irradiation experiments are usually conducted over a period of several months, and an efficient computer code is required to determine the temperature in the fuel specimens on a daily basis. To achieve this efficiently, the thermal calculations are calculated with a one-dimensional model which is modified by shape factors to approximate the two-dimensional or three-dimensional effects which exist in the fuel capsules. To date only axisymmetric cells have been analyzed. General test information and daily test data are read as input to the code. The output consists of the capsule temperature history and the daily nuclear status of the fuel samples. Included in the output is an uncertainty interval for the fuel centerline temperature based on estimated uncertainties in the input data. The code has extensive printing and plotting options which allow wide generality in the selection and presentation of the output. (auth)

17130 PLUTONIUM MIGRATION IN HIGH TEMPERATURE OXIDE FUEL. Demas, Nicholas George. Madison, Wis.; Univ. of Wisconsin (1971). 133p. University Microfilms Order No. 71-24,452.

Thesis.

A model is constructed for the migration of Pu in high temperature oxide fuel. The model is applied to vibratory compacted mixed oxide UO_2, PuO_2 fuel elements. The resulting calculated Pu distributions are compared with measured data from the post irradiated elements. The agreement between calculated and measured Pu distributions indicates the essential completeness of the model used. The model is based on the action of four mechanisms: (1) The evaporation in hot regions, the migration through open porosity and the condensation in cooler regions of UO_3. (2) The preferential concentration of Pu on the hot face of a migrating void due to UO_3 vapor pressure. (3) The gravitational flow of molten oxide when center melting of the fuel element occurs. (4) The solid state migration of Pu driven by a thermal gradient. The first three mechanisms operate quickly during the first day of fuel element exposure and the fourth operates slowly over the rest of the fuel element life. The model developed to calculate the Pu distributions in the experimental samples was used to calculate the Pu distribution in design type fuel elements. The results and implications of these calculations of design type fuel elements are discussed. (Diss. Abstr. Int., B)

17131 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR CORES. (to Creusot-Loire). British Patent 1,257,487. 22 Dec 1971. Priority date 6 May 1969, France.

REACTORS, GAS COOLED — reflector assembly for graphite moderated, configuration of top

REACTORS, GRAPHITE MODERATED — reflector assembly for gas cooled, configuration of top (H.D.R.)

17132 EVOLUTION OF MEASURING AND CONTROL EQUIPMENT FOR NUCLEAR REACTORS ON THE FRENCH MARKET. Guerre, J. (Societe Merlin Gerin, Grenoble, France). Kerntech. Atomprax.; 13: No. 11, 478-81(Nov 1971).

Measuring and control equipment for nuclear reactors is in a process of continuous evolution. Considerable progress has been achieved both on the design and on the implementation side, made possible by the advent of novel components and by the development of new measuring procedures. "Multibloc" equipment is discussed. The main emphasis is on recent developments. (auth)

17133 MANUFACTURE OF NUCLEAR FUEL ELEMENTS. Pollet, M.; Baschwitz, R.; Serole, B.; Thiebaut, B. (Compagnie pour l'Etude et la Realisation de Combustibles Atomiqaues, Paris). Kerntech. Atomprax.; 13: No. 11, 488-90(Nov 1971).

The manufacture of laminated fuel elements containing specially sintered fuels and clad by resisting light alloys, the manufacture of ceramic fuel elements for pressurized-water reactors, and the manufacture of coated particles for high-temperature reactors are described. (auth)

17134 NUCLEAR FUEL PIN SUB-ASSEMBLY. Agranier, Jean-Claude; Cayol, Andre (to Commissariat a l'Energie Atomique). British Patent 1,257,410. 15 Dec 1971. Priority date 19 Sep 1969, France.

REACTOR FUEL ELEMENTS — fabrication of sodium cooled, shroud enclosed fuel pin sub-assemblies for

REACTORS, LIQUID METAL COOLED — fuel elements for, shroud enclosed fuel pin sub-assemblies for (H.D.R.)

17135 HYDRAULIC DRIVE FOR EMERGENCY SHUTDOWN OF NUCLEAR REACTORS. Acher, Heinz; Obenauf, Eberhard (to Licentia Patent-Verwaltungs GmbH). U. S. Patent 3,627,632. 14 Dec 1971. Priority date 24 Nov 1967, Germany.

Hydraulic drive system is described for effecting the emergency shutdown by control rods of a nuclear reactor in which a guide housing is connected to the pressure vessel of the reactor. A control rod drive piston is movably mounted in a guide housing connected to the reactor. Such drive piston and guide housing together form a drive chamber on one side of the drive piston and a counterpressure chamber on the other side. The drive chamber is connected to a pressure medium chamber in the pressure vessel and to the counterpressure chamber such that, when the counterpressure chamber is opened to atmosphere, pressure medium flows from the pressure medium chamber into the drive chamber to move the drive piston; hence, the control rod connected thereto, rapidly into the emergency shutdown position. (auth)

17136 NUCLEAR REACTOR CONTROL ROD ASSEMBLY. Aleite, Werner; Bortolazzi, Kurt (to Siemens Aktiengesellschaft). U. S. Patent 3,625,816. 7 Dec 1971. Priority date 28 Jun 1968, Germany.

Control rod assembly for nuclear reactors includes a plurality of finger control rods carried in common by a spiderlike holder and mechanical drive mechanism for displacing the holder vertically to insert the finger control rods into a plurality of fuel elements. The finger control rods contain neutron-absorbing substance along at least part of the length. The device for mounting a plurality of neutron-absorbing shutoff rods outside the reactor core is described. The mounting means are releasable during abnormal operation of the reactor for inserting the shutoff rods into the fuel elements. Entrainment means are operatively connected to and displaceable with the finger control rod holder. (auth)

17137 NUCLEAR FUEL ROD. Kerr, John M.; Larson, Gordon C. (to Babcock and Wilcox Co.). U. S. Patent 3,625,823. 7 Dec 1971. Filed 9 Jul 1968.

A sheathed nuclear fuel rod is described which is sealed by end caps and which has foamed zirconia plugs which separate and thermally insulate the end caps from the fuel material. The end caps also provide internal support for the sheathing and for the fuel. (auth)

17138 FUEL-ELEMENT COATING CONTAINING BURNABLE POISON. Ricks, Herbert E. (to Westinghouse Electric Corp.). U. S. Patent 3,625,821. 7 Dec 1971. Filed 26 Jun 1968.

A fuel element for a nuclear reactor is described having a fuel cladding tube with the inner surface of the tube being coated with a retaining metal of low neutron capture cross section and having finely dispersed particles of a burnable poison disposed therein. (auth)

17139 PNEUMATIC CONTROL ROD DRIVE INCLUDING A SCRAM CUSHION. Taft, William E. (to United States Atomic Energy Commission). U. S. Patent 3,613,512. 19 Oct 1971. Filed 16 Oct 1969.

A control rod drive for a nuclear reactor includes a vertically disposed pneumatic cylinder containing a piston having shafts extending above and below the piston. The lower shaft is connected to the control rod and the upper shaft extends through a second, short pneumatic cylinder to terminate in an enlarged head. Air is supplied to the pneumatic cylinder below the piston during normal operation of the reactor to force the enlarged head of the upper shaft against a stop nut on a lead screw, the position of the stop nut on the lead screw determining the position of the control rod within the reactor. To scram the reactor high-pressure air is admitted to the pneumatic cylinder above the piston while the air below the piston is simultaneously exhausted. Deceleration of the control rod is obtained by admitting the high-pressure air used for scramming the reactor through a check valve into the second, short pneumatic cylinder below a free-floating piston. When the upper shaft head contacts the piston air is compressed in the second cylinder cushioning the fall of the control rod. A bleed line is provided by passing the check valve and connecting the short cylinder to the scram gas line. (auth)

17140 GERMAN IMPORT AND EXPORT OF FUEL MATERIALS IN 1970. Atomwirt., Atomtech.; 17: No. 1, 22-3(Jan 1972). (In German).

A survey of the import and export of unirradiated uranium of various enrichments, ^{239}Pu, Th, etc., by the West German Republic is presented in tabular form. The country of origin and receipt is given for specified kg amounts. Similar data is available for Belgium/Luxemburg and Great Britain as consumers of irradiated fuels from Germany. (K.S.W.)

Reactor Physics and Core Engineering

17141 (AECL–4074) DEPENDENCE OF THE THERMAL DIFFUSION AREA OF A ROD LATTICE ON ROD DIPOLE RESPONSE COEFFICIENT. Stewart, J. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov 1971. 26p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Expressions for the thermal diffusion areas of a rod lattice are obtained by simplifying assumptions in an attempt to make as clear as possible the dependence of these areas on the rod dipole response coefficient. 5 references. (auth)

17142 (ORNL-TM-3164) ESP: A GENERAL MONTE CARLO REACTOR ANALYSIS CODE. Cramer, S. N.; Carlsmith, R. S.; Morrison, G. W.; Perry, G. W.; Lucius, J. L. (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 302p. Dep. NTIS.

The ESP code is a general purpose steady-state Monte Carlo reactor analysis code. It covers the complete energy range of interest in reactor calculations and is designed for both eigenvalue and fixed source reactor and reactor cell calculations. Basic data are accepted only in the ENDF/B format. In addition to smooth data, the cross-section preparation includes a detailed treatment of resolved and unresolved resonances and the free gas and $S(\alpha,\beta)$ thermal models. The collision and source routines utilize the ENDF/B non-elastic secondary distributions, the anisotropic scattering data, and the fission spectra. The energy range may be divided into as many as 25,000 intervals, and over each interval the appropriately averaged cross sections are used as constant point-energy values. A general geometry description is available, as well as several specialized geometries. Use of fixed-source options allows calculations on non-multiplying systems. ESP may be run in its entirety with only one problem setup and computer pass. No subroutine or tape preparation is necessary. The analysis of neutron histories is performed in computer core for many quantities of interest usually wanted in reactor calculations. Included among these are neutron fluxes, reaction rates, and cross sections, averaged over arbitrary energy and spatial regions. (22 references) (auth)

17143 MODERN POWER STATION PRACTICE. VOLUME 8. NUCLEAR POWER GENERATION. Second Revised and Enlarged Edition. Elmsford, N. Y.; Pergamon Publishing Company (1971). 392p. $14.00.

An overall description of the use of nuclear reactors for electrical power generation is presented. Nuclear physics and the types of reactors used as heat sources are discussed. The siting, design, and layout of British nuclear power plants are described, and the operation and safety of nuclear stations are examined. Aspects of reactor commissioning and health physics are included. (H.D.R.)

Physics

Refer also to abstracts 16484 and 17111.

17144 (ANL–7843) COMPACT REPRESENTATION OF SPACE-DEPENDENT TRANSFER FUNCTIONS. Ameglio, Paolo (Argonne National Lab., Ill.). Jul 1971. Contract W-31-109-eng-38. 80p. Dep. NTIS.

Space-dependent transfer functions can in some cases be given a compact representation through application of the Poisson sum formula. The one- and two-group bare-reactor examples are presented. The results should be useful for tutorial purposes as well as for the analysis of simple experiments. 28 references. (auth)

17145 (IA–1234) ERROR ESTIMATE DUE TO SPACE PERTURBATION IN REACTOR PROBLEMS. Ronen, Y. (Israel Atomic Energy Commission, Tel Aviv). Jul 1971. 8p. Dep. NTIS (U. S. Sales Only).

The functional analysis technique for obtaining an error estimate is applied to space perturbation in a reactor with slab geometry. A bound to the change in reactivity due to a space perturbation is obtained. (auth)

17146 (INDC(CCP)–19/U) PLANNING AN OPTIMUM SET OF MICROSCOPIC EXPERIMENTS AND EVALUATION TO OBTAIN A GIVEN ACCURACY IN REACTOR PARAMETER CALCULATIONS. Usachev, L. N.; Bobkov, Yu. G. (International Nuclear Data Committee). Jan 1972. 14p. Dep. NTIS (U. S. Sales Only).

The accuracy required of microscopic nuclear data to ensure a given accuracy in the calculation of reactor parameters is analyzed. A general method of allowing for the correlations of errors in microscopic quantities relating to different processes, energy groups and isotopes is described. The error is considered to consist of components differing in correlation properties. By dividing the error into components, it is possible to obtain simple formulae for linking these components with the required accuracy of a reactor parameter. "Experiment planning" methods to obtain a mathematical formulation of the problem of determining the least costly complex of experiments which will ensure a given accuracy in the calculation of a reactor parameter are discussed. The solution to this problem is obtained in the form of simple formulae. The requirements relating to all error components are calculated. It is shown that the requirements can be eased if the same method is used to measure neutron fluxes in experiments on fission and capture cross-sections. The error in curve normalization is shown to be of particular importance, and the special role of evaluation in determining this error is stressed. (5 references) (auth)

17147 (MIT–3903-5) FINITE ELEMENT METHODS FOR SPACE–TIME REACTOR ANALYSIS. Kang, Chang Mu; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Nov 1971. Contract AT(30-1)-3903. 192p. (MITNE–135). Dep. NTIS.

Thesis. Submitted by Chang Mu Kang.

Finite element methods are developed for the solution of the neutron diffusion equation in space, energy and time domains. Constructions of piecewise polynomial spaces in multiple variables are considered for the approximation of a general class of piecewise continuous functions such as neutron fluxes and concentrations of nuclear elements. The approximate solution in the piecewise polynomial space is determined by applying the Galerkin scheme to a weak form of the neutron diffusion equation. A piecewise polynomial method is also developed for the solution of first-order ordinary differential equations. The numerical methods are applied to neutron slowing-down problems, static neutron diffusion problems, point kinetics problems and time-dependent neutron diffusion problems. The uniqueness, stability and approximation error of the numerical methods are considered. The finite element methods yield high-order accuracy, depending on the degree of the polynomials used, and thereby permit coarse-mesh calculations. The conventional multigroup method, the Crank–Nicolson and Padé schemes are shown to be special cases of the finite element methods. Numerical examples are presented which confirm the truncation error and demonstrate the utility of the finite element methods in reactor problems. 54 references. (auth)

17148 NUCLEAR REACTOR COMPUTER STUDY FOR A TWO GROUP, TWO REGION MODEL. Eckley, Wayne F.; Wiggins, Peter F. (United States Naval Academy, Annapolis, Md.). Nav. Eng. J.; 83: No. 6, 78-82(Dec 1971).

The computation of critical size for a reflected nuclear reactor is a complex problem. To obtain a rough approximation of the critical size and mass of the system, one group (energy level) of the neutrons could be used. However, because neutrons are released from the fission process in an energy spectrum with some neutron energies up to almost 10 MeV, it is necessary to introduce more energy groups. The use of a time sharing digital computer system enabled the effect of the critical size and the flux distribution to be studied in a spherical reflected reactor using two energy groups, fast (2 MeV) and thermal (0.025 eV), given an operating temperature and fuel (percent enrichment of uranium-235). (auth)

17149 PULSED NEUTRON EXPERIMENTS IN GRAPHITE. McFarlane, Harold Finley. Pasadena, Calif.; California Inst. of Tech. (1971). 135p. University Microfilms Order No. 72-478.

Thesis.

Detailed pulsed neutron measurements were performed in graphite assemblies ranging in size from 30.48 cm × 38.10 cm × 38.10 cm to 91.44 cm × 66.67 cm × 66.67 cm. Results of the measurement were compared to a modeled theoretical computation. In the first set of experiments, the effective decay constant of the neutron population in ten graphite stacks as a function of time after the source burst was measured. The decay was found to be non-exponential in the six smallest assemblies, while in three larger assemblies the decay was exponential over a significant portion of the total measuring interval. The decay in the largest stack was exponential over the entire ten millisecond measuring interval. The non-exponential decay mode occurred when the effective decay constant exceeded 1600 sec^{-1}. In a second set of experiments, the spatial dependence of the neutron population in four graphite stacks as a function of time after the source pulse was measured. By doing a harmonic analysis of the spatial shape of the neutron distribution, the effective decay constants of the first two spatial modes were determined. In ad-

dition, the time dependent effective wave number of neutron distribution in the stacks was calculated. A Laplace transform technique and a simple modeled scattering kernel were used to solve a diffusion equation for the time and energy dependence of the neutron distribution in the graphite stacks. Comparison of these theoretical results with the results of the first set of experiments indicated that more exact theoretical analysis would be required to adequately describe the experiments. The implications of experimental results for the theory of pulsed neutron experiments in polycrystalline media are discussed. (Diss. Abstr. Int., B)

17150 SYNTHESIS QUASISTATIC MODEL AND SPATIAL EFFECTS IN TWO-DIMENSIONAL NEUTRON DYNAMICS MODELS FOR FAST REACTOR ACCIDENTS. Smith, LaRon Lloyd. Lafayette, Ind.; Purdue Univ. (1971). 235p. University Microfilms Order No. 72-1953.

Thesis.

A new space dependent neutron dynamics model was developed to predict the time behavior of the neutron flux in a two-dimensional model for a fast reactor by approximating the solution to the two-dimensional, time dependent, multigroup neutron diffusion equations. This model is based on the quasistatic method for neutron kinetics in which the time dependent neutron flux is separated into a flux amplitude which depends only on time and a flux shape which is weakly time dependent. The two-dimensional flux shape is approximated by the product of a one-dimensional, time dependent, axial flux distribution and a time dependent radial shape factor determined from a one-dimensional, time dependent, radial flux distribution; hence, the model is called the synthesis quasistatic model. The one-dimensional flux distributions are the solutions to the quasistatic flux shape equations for the one-dimensional geometries which represent the lines of symmetry of the reactor model. For the study of spatial effects in fast reactor disassembly calculations, a multichannel disassembly model was coupled to the synthesis quasistatic model. In this model, the material motion is restricted to the axial direction in each radial channel. A comparison of the results of the synthesis quasistatic model and the point kinetics model was performed for several model accidents involving sodium voiding and reactor disassembly. The deviations between spatial and point kinetics were deliberately reduced in the sodium void accidents by simulating the passage of a gas bubble through the reactor core and thus eliminating the coupling between power production and sodium boiling. To reduce the deviations for the disassembly investigations, the same reactivity ramp was used for both spatial and point kinetics at the start of disassembly. The comparisons show that spatial kinetics seems to predict a significantly larger energy release in the sodium void accidents even without the coupling effect which would amplify the difference. However, by modifying the point kinetics model, a large part of the observed difference can be eliminated. Two general conclusions appear to be indicated by the disassembly studies: The energy release above the fuel vaporization point predicted by the point kinetics model is considerably less than that predicted by the spatial kinetics model when the disassembly is comparatively mild (e.g., when the material motion begins early in the transient or for small reactivity ramps where the reactivity barely exceeds one dollar). On the other hand, for a violent disassembly, the error in the point kinetics prediction is small (≃10%). (Diss. Abstr. Int., B)

17151 APPROXIMATE MONTE CARLO TREATMENT OF RESONANCE ABSORPTION IN REACTOR LATTICES. Bingman, Bruce Michael. Evanston, Ill.; Northwestern Univ. (1971). 91p. University Microfilms Order No. 71-30,745.

Thesis.

Neutron transport through reactor lattices is examined using stochastic techniques and the collision probability approximation to the Boltzmann equation. While introducing very little systematic error for lattices with dimensions that are not large in mean free paths, the collision probability formulation reduces the required computational effort by replacing the detailed space-angle transport calculations with a simplified stochastic determination of regions and energies at which neutrons make successive collisions. Methods of calculating cross sections in the unresolved resonance region are also examined. Resonance parameters are calculated by directly sampling the appropriate energy-spacing and width distributions at the time of each collision. This procedure is valid provided the average energy loss per collision is sufficiently larger than the resonance spacing to yield uncorrelated cross sections at successive collisions. The reliance on a particular resonance ladder and on a large computer memory is eliminated without incurring significantly increased computation times. The method is applied to two-region slab and cylindrical cells where it results in reduced computation times with no increase in variance when compared with a conventional Monte Carlo calculation. The method is then used to determine group cross sections for a ten-region fast critical assembly lattice, and results are compared to those obtained by Argonne National Laboratory. (Diss. Abstr. Int., B)

17152 NUCLEAR REACTOR TRANSIENT ANALYSIS. Krolick, Cyril Francis. College Park, Md.; Univ. of Maryland (1971). 122p. University Microfilms Order No. 72-627.

Thesis.

The multi-group kinetics equations which describe feedback-limited nuclear reactor transients are solved using the method of the Lie Series. Solutions are presented for both the point reactor and space–time dependent cases. Computer programs written for the UNIVAC 1108 Computer, along with several trial calculations are also included. The point kinetics solution uses the flux shape at delayed critical as the shape function for the response calculations. In the space–time solution, the spatial derivative is expressed in finite-difference form. For both cases the feedback is assumed to be proportional to the integrated neutron density and the coefficient of proportionality is taken as a constant which is related to the reactor temperature. Comparisons of Lie Series with other computational techniques and with TREAT experiments are included. The relationships between point kinetics approximations and space–time dependent solutions are also discussed. (Diss. Abstr. Int., B)

17153 VARIATIONAL METHOD APPLIED TO THE NEUTRON TRANSPORT EQUATION. Kim, Sang Won; Pac, Pong Youl (Seoul National Univ.). J. Korean Nucl. Soc.; 3: No. 4, 203-8 (Dec 1971).

Noether's theorem is applied to the one dimensional neutron transport equation. The transformation rendering the functional of the one dimensional Boltzmann equation invariant is obtained. The law conserving the product of the directional flux and its adjoint flux is derived. The possible types of the solution of the Boltzmann equation are discussed. (auth)

17154 FINITE ELEMENT METHOD APPLIED TO REACTOR PHYSICS PROBLEMS. Ohnishi, Tadahiro (Atomic Energy Research Lab., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 8: No. 12, 717-20(Dec 1971).

The finite element method can be regarded as an extension of the Ritz finite difference approximation. The two dimensional neutron diffusion equation in x-y geometry is considered in the frame of the three-node first-order triangular finite element. (auth)

17155 PRECISION OF COHERENCE FUNCTION MEASUREMENTS. Vaurio, J. K. (Helsinki Univ. of Tech., Otaniemi, Finland). J. Nucl. Energy; 26: No. 1, 44-7(Jan 1972).

Coherence function measurements have been preformed in nuclear reactor noise analysis for both high-power and zero-power reactors. As a dimensionless quantity bounded to the interval [0, 1] it is a suitable measure of the mutual relation between two random signals. A simple theoretical expression is derived for the statistical variance of a coherence function, together with some general covariance relations. The accuracy of a conventional coherence function measurement is compared with that of an interesting polarity correlation method. Finally, the best statistical accuracies of the parameters in a point reactor model are given. The results may be used for design and optimization purposes. (auth) (UK)

17156 SEMIGROUP THEORY AND ITS APPLICATION TO SPACE–TIME NUCLEAR REACTOR DYNAMICS. Crawford, Raymond M. (Argonne National Lab., Ill.); Kastenberg, William E. Nucl. Sci. Eng.; 47: No. 2, 238-41(Feb 1972).

The methods of semigroup theory are extended and applied to the space-time reactor dynamics equations. The extension allows one to obtain an upper bound on the maximum value of the state variables as well as a stability criteria based on the L_∞ norm. Several important questions relating to obtaining bounds on the linear operators of reactor theory are answered. The importance of considering the L_∞ or max norm is discussed and the main results are applied to an illustrative example. (auth)

17157 SOME IMPLICATIONS OF A STOCHASTIC NEUTRON POPULATION MODEL WITH FEEDBACK. Daniak, Donald J. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng.; 47: No. 2, 230-4(Feb 1972).

A derivation of the time-dependent forward stochastic equation is sketched for a point reactor with linear feedback and an arbitrary finite fission neutron frequency distribution. Certain pathological characteristics of possible stochastic trajectories are discussed, and limiting conjectures are made based on physical considerations. The time-independent forward stochastic equation with negative reactivity feedback is solved in the classical manner, leading to recursion relation for the long-run probabilities. All factorial moments of the long-run distribution are shown to be finite, and the corresponding probabilities, $P(N,\infty)$, are thus

$o(N^{-k})$ for any integer k. A more tractable recursion relation is presented for the simpler case of binary fission. For this simple model, the equivalence to an independent analysis of the Kolmogorov forward matrix equations is demonstrated. A simple recursion relation among factorial moments of the long-run distribution is derived for the binary fission model. (auth)

17158 CALCULATION OF REACTIVITY PERTURBATIONS WITH THE MONTE CARLO METHOD. Matthes, W. (CCR-EURATOM, Ispra, Italy). Nucl. Sci. Eng.; 47: No. 2, 234-7 (Feb 1972).

A general Monte Carlo procedure is presented for the calculation of perturbations in the reactivity of a multiplying system due to changes in system parameters (e.g., temperature, control rod positions). The procedure is based on the perturbation theory formula which gives the reactivity change δk exact up to terms of second order if the fission density distribution (and) or the corresponding adjoint function are known up to first order. As this formula makes full use of the properties of the importance (adjoint) function, a Monte Carlo procedure is developed for the evaluation of the adjoint function also. (auth)

17159 ERROR ESTIMATES IN REACTOR THEORY. Ronen, Yigal (Atomic Energy Commission, Beer-Sheva, Israel). Nucl. Sci. Eng.; 47: No. 2, 195-202(Feb 1972).

An analytic method for error estimate is applied to reactor theory. The method is based on the functional analysis technique and gives upper bounds to the errors. There are two main advantages to the method. First, error estimates can be obtained in cases for which no other known method succeeds. Second, any upper bound to the error obtained by this method is reliable. This method finds an upper bound to the errors in the eigenvalues of homogeneous equations and in the relative RMS solutions of the inhomogeneous equations. When the method is applied to the inhomogeneous integral transport equations, upper bounds to the relative RMS of the fluxes result. Application of the method is further extended to homogeneous equations such as the integral transport equations and even to unbounded equations such as diffusion equations. For these cases the errors in reactivity and time decay constants are studied. (auth)

17160 VARIATIONAL SYNTHESIS WITH DISCONTINUOUS TRIAL FUNCTIONS: COMMENTS ON A PAPER BY LAMBROPOULOS AND LUCO. Nelson, Paul Jr. (Oak Ridge National Lab., Tenn.). J. Nucl. Energy; 26: No. 1, 43-4(Jan 1972).

An argument is put forward in support of singular contributions to the integrals appearing in variational functions. In particular it is argued that, contrary to the views of Lambropoulos and Luco, the convention $\int_{-\alpha}^{\infty} H(x)\delta(x)dx = \frac{1}{2}$, where H is the Heaviside step function and δ is the Dirac delta function, can be given rigorous interpretation. (UK)

17161 MEASUREMENT OF THE THERMAL NEUTRON WAVE DISPERSION RELATIONS IN BeO. Ritchie, A. I. M.; Whittlestone, S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Energy; 26: No. 1, 27-41(Jan 1972).

The amplitudes and phase shifts of thermal neutron waves were measured in a block of BeO 60.96 × 60.96 × 58.42 cm^3 of average density 2.87 g cm^{-3} and having nominal transverse buckling of 0.0048 cm^{-2}. The attenuation constants (α) and phase shift constants (ξ) were derived from such measurements at 18 frequencies covering the range 52.4–506.1 Hz. The parameters $\alpha^2-\xi^2$ and $2\alpha\xi$ were evaluated, normalized to a reference density of 2.96 g cm^{-3}, and corrected for the density normalized transverse bucking of 0.00513 cm^{-2}. The normalized and corrected parameters $\alpha^2-\xi^2$ and $2\alpha\xi$ were fitted to polynomials in the angular frequency ω, and the resulting thermal neutron diffusion parameters were compared with those derived from a $\lambda(B^2)$ experiment carried out on the same block of BeO. The parameters λ_a and L determined by the two methods were in good agreement, but the diffusion coefficient and diffusion cooling constant derived from the sine wave experiment were significantly higher. The high diffusion coefficient (by ~9%) could be due to the effect of the sub-Bragg continuum, although the values of the parameters α and ξ appeared to be independent of the distance from the source. Agreement of the parameters $\alpha^2-\xi^2$ and $2\alpha\xi$ with the theoretical values was not good and reasons are advanced for the discrepancy. (auth) (UK)

17162 INTEGRAL-VERSIONS OF THE AREA-RATIO METHOD OF PULSED NEUTRON REACTIVITY MEASUREMENTS. Kosaly, G.; Fischer, A. (Central Research Inst. for Physics, Budapest). J. Nucl. Energy; 26: No. 1, 17-26(Jan 1972).

A method for the measurement of the shut-down reactivity is suggested. It involves area-ratio measurements at several points inside the core, and uses auxiliary static calculations. While the method is completely general, only the case of thermal reactors is discussed in detail. (auth) (UK)

Core Thermal Hydraulics

17163 (DOCKET-50219–164) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Control Rods Latching at Position 02. (Jersey Central Power and Light Co., Morristown, N. J.). 25 Jan 1972. 2p. Dep. NTIS.

17164 (DOCKET-50231–108) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Failure of Main Secondary Expansion Tank Low Level Trip. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 21 Jan 1972. 4p. Dep. NTIS.

17165 (DOCKET-50255–67) PALISADES PLANT. Information on Scram Circuit Breakers. (Division of Compliance (AEC), Glen Ellyn, Ill. Region III). 18 Jan 1972. 2p. Dep. NTIS.

17166 INCIPIENT BOILING OF SODIUM AND ITS APPLICATION TO REACTOR SYSTEMS. Holtz, Robert Edward. Evanston, Ill.; Northwestern Univ. (1971). 171p. University Microfilms Order No. 71-30,833.

Thesis.

Experimental measurements of incipient-boiling superheats were obtained in a sodium pool-boiling apparatus which employed an electromagnetic pump as the means for applying pressure to the system (i.e., no inert gas was present in the system). The sodium used for these tests was taken from the EBR-II primary system. The experimental results supplied the following information. (1) A large incipient-boiling superheat can result in the boiling surface losing a previously established pressure-temperature history. The proposed mechanism by which this occurs is a large thermal stress at the boiling surface caused by the severe temperature gradient at the boiling surface during vaporization. This large thermal stress results in plastic deformation of the boiling surface (i.e., surface cracking). (2) When the pressure-temperature history is reestablished for at least 20 min prior to each test run, the incipient-boiling superheats show good agreement with the pressure-temperature modeling technique if a ratio for the receding to advancing radii of curvature of about 0.34 is employed. This ratio of receding to advancing radii is in excellent agreement with contact angle data. Also, by reestablishing the history for a minimum of 20 min, the scatter of superheat data is considerably reduced. (3) The incipient-boiling superheat appears independent of the approach to boiling. Data obtained approaching boiling both by increasing the temperature at constant pressure and by decreasing the pressure at constant temperature are in agreement. (4) The presence of a partial pressure of inert gas in the surface cavities can significantly lower the incipient-boiling superheat. In addition to the experimental investigation, an analysis of the application of the incipient superheat model to reactor systems was accomplished. As demonstrated by the experimental investigation, this study shows the key roles of the pressure-temperature history and the partial pressure of inert gas in the surface cavities upon the incipient-boiling superheats during various postulated reactor accidents. These two parameters are highly dependent upon the reactor plant design and the steady-state operating conditions of the reactor system. Calculations demonstrate that relatively high incipient-boiling superheats occur during various postulated accidents in pot-type reactors, while relatively small incipient superheats occur during postulated accidents in loop-style reactors. (Diss. Abstr. Int., B)

GENERAL

Civilian Defense

Refer also to abstract 15519.

Law

Refer also to abstracts 15067, 15457, and 15856.

17167 CIVIL LIABILITIES FOR NUCLEAR DAMAGE. Nasim, M. (Pakistan Atomic Energy Commission, Karachi). Nucleus (Karachi); 8: No. 3, 77-81(Jul-Sep 1971).

The need for legal means to ensure satisfactory financial compensation in the event of nuclear damage is highlighted. The paper also reviews the important features of the various international conventions on civil liabilities. (auth)

17168 (EUR-4668) SYMPOSIUM ON EDUCATION AND TRAINING OF WORKERS IN RADIOPROTECTION, BRUSSELS, BELGIUM, DECEMBER 16-18, 1969. (European Atomic Energy Community). Jun 1971. 282p. (In French). (CONF-691211).

Radiation protection programs in the countries comprising the European Atomic Energy Community are reviewed. Difficulties encountered in obtaining personnel trained in radiation protection personnel are outlined and courses that may be taken by correspondence are listed. (C.H.)

17169 (SZS-11/71) EXPLANATION OF THE AUTHORIZATION PROCEDURE FOR THE OPERATION OF MEDICAL X-RAY EQUIPMENT. Menzel, B.; Taschner, P.; Koenig, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1971. 40p. (In German). Dep. NTIS (U. S. Sales Only).

In the GDR the operation of x-ray equipment must be licensed by the National Centre for Radiation Protection. The licence is granted on the basis of an evaluation of the technical and personal qualifications of the applicant. For the users of medical x-ray equipment the relevant sections of the Radiation Protection Ordinance are outlined. Detailed advice is provided for applicants regarding the preparation of the documentation which must be submitted to the Centre, and the performance of radiation protection supervision. (auth)

Miscellaneous

17170 (ACRH-36) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Gottschalk, Alexander (ed.) (Argonne Cancer Research Hospital, Chicago, Ill.). Sep 1971. Contract AT(11-1)-69. 135p. Dep. NTIS.

17171 (AEC-tr-7124) COMPUTER ELEMENTS AND SYSTEMS. Proceedings of a Symposium in Novosibirsk, May 1966. Translation of Vychislitel'nye Sistemy. Trudy Simpoziuma, G. Novosibirsk, Mai 1966 G. 206p. (TT-70-50012; IPST-Cat.-5706). Dep. NTIS.

17172 (AECL-3794) AN IMPROVED REED PENDULUM APPARATUS AND TECHNIQUES FOR THE STUDY OF INTERNAL FRICTION OF CERAMIC SINGLE CRYSTALS. Sprungmann, K. W.; Ritchie, I. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Nov 1971. 34p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

17173 (AECL-3904) HIGH VOLTAGE ELECTRON MICROSCOPY. Ploc, R. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov 1971. 54p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

17174 (ANL-7888) DEVELOPMENT OF HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Progress Report, July 1970-June 1971. Cairns, E. J.; Steunenberg, R. K.; Ackerman, J. P.; (and others) (Argonne National Lab., Ill.). Dec 1971. Contract W-31-109-eng-38. 87p. Dep. NTIS.

17175 (BDX-613-261) TYPIST'S GUIDE TO BENDIX KANSAS CITY TECHNICAL REPORTS. Walker, Floyd A. (Bendix Corp., Kansas City, Mo.). Jan 1972. Contract AT(29-1)-613. 89p. Dep. NTIS.

17176 (BDX-613-279) DRILLING PRINTED CIRCUIT BOARDS. PDO 6984221, Final Report. Gillespie, L. K. (Bendix Corp., Kansas City, Mo.). Jan 1972. Contract AT(29-1)-613. 205p. Dep. NTIS.

17177 (BDX-613-442) LINE OF BALANCE ACCURACY. Final Report. Claggett, S. F. (Bendix Corp., Kansas City, Mo.). Nov 1971. Contract AT(29-1)-613. 33p. Dep. NTIS.

17178 (BDX-613-585) BIBLIOGRAPHY: MACHINING MINIATURE PARTS AND MINIATURE FEATURES. PDO 6984735. Gillespie, L. K. (Bendix Corp., Kansas City, Mo.). Dec 1971. Contract AT(29-1)-613. 31p. Dep. NTIS.

17179 (BDX-613-593) DEBURRING: A BIBLIOGRAPHY. PDO 6984405, Topical Report. Gillespie, L. K. (Bendix Corp., Kansas City, Mo.). Dec 1971. Contract AT(29-1)-613. 33p. Dep. NTIS.

17180 (BMI-171-139) AMCHITKA BIOENVIRONMENTAL PROGRAM, PLANT ECOLOGY OF AMCHITKA ISLAND. Final Report. Amundsen, C. C. (Tennessee Univ., Knoxville. Dept. of Botany). Jan 1972. Contract AT(26-1)-171. 47p. Dep. NTIS.

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17181 (BNL-16340) SALT, HEREDITY, AND HYPERTENSION. Knudsen, Knud D.; Iwai, Junichi; Dahl, Lewis K. (Brookhaven National Lab., Upton, N. Y.). [1971]. 27p. (CONF-711211-1). Dep. NTIS.

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17187 (BNWL-1629) ANNUAL SUMMARIES OF MICROCLIMATOLOGICAL DATA FROM THE ARID LANDS ECOLOGY RESERVE: 1968 THROUGH 1970. Hinds, W. T.; Thorp, J. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1971. Contract AT(45-1)-1830. 38p. Dep. NTIS.

17188 (BNWL-1632) PDP-9 SOFTWARE SYSTEM WITH A DDC FIXED-HEAD-DISC MEMORY. Gerhardstein, L. H.; Burnett, R. A.; Friedrichs, D. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 24 Nov 1971. Contract AT(45-1)-1830. 91p. Dep. NTIS.

17189 (BNWL-SA-2733) BIOTIC AND ABIOTIC CHARACTERISTICS OF THE MICROCLIMATOLOGICAL NETWORK ON THE ARID LANDS ECOLOGY RESERVE. Hinds, W. T.; Thorp, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr 1969. Contract AT(45-1)-1830. 57p. Dep. NTIS.

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17193 (CERN–71–26) SOME METHODS FOR AUTOMATIC INTEGRATION AND THEIR IMPLEMENTATION ON THE CERN CDC 65/6600 COMPUTERS. Havie, T. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Dec 1971. 44p. Dep. NTIS (U. S. Sales Only).

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From Proceedings of the 7th Federation of European Biochemical Societies meeting; Varna, Bulgaria (19 Sep 1971).

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17203 (COO–1574–28) PROPERTIES OF RARE-GAS SOLIDS. Technical Progress Report. (Michigan State Univ., East Lansing). [1971]. Contract AT(11–1)–1574. 12p. Dep. NTIS.

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ALS. Baerwald, H. G. (Sandia Labs., Albuquerque, N. Mex.). Jul 1971. 24p. Dep. NTIS.

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17313 (TID-25896) BIOCHEMICAL STUDIES ON THE OCULAR LENS IN RELATION TO CATARACTOGENESIS. Triennial Report, 1968-1971. Kinsey, V. Everett; Reddy, V. N. (Oakland Univ., Rochester, Mich. Inst. of Biological Sciences). Contract AT(11-1)-2012. 9p. Dep. NTIS.

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Oak Ridge, Tenn. Y-12 Plant). 2 Feb 1972. Contract W-7405-eng-26. 27p. Dep. NTIS.

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Appendix 1

SCOPE AND SECTION ARRANGEMENT OF NUCLEAR SCIENCE ABSTRACTS

Introduction

This appendix defines the subject scope and arrangement of the literature in *Nuclear Science Abstracts (NSA)* beginning with this issue.

Nuclear science is the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, gamma rays, and x rays.

Nuclear technology is the application of nuclear science to other sciences and engineering, and conversely, the application of other sciences and engineering to the problems of nuclear science.

Part 1 identifies the major fields of nuclear science and technology into which *NSA* is divided. Subdivisions are listed under each field. Subdivisions are followed by statements of specific subject interest. These statements have been prepared to show the exact range and limits of subject interest for selecting literature abstracted and indexed in *NSA*.

Part 2 identifies the extent of interest in the chemical elements.

NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. Selection is based on subject content; nothing is excluded solely on the basis of form, origin, or language. Some of the general practices followed in selecting literature for *NSA* are as follows:

1. Popular type articles are not included.
2. Textbooks below the graduate level are not included.
3. Theses below the doctoral level are not included.
4. Patents that have been filed in several countries are included only once.
5. Material existing only as abstracts or short summaries is not included except for papers summarized in the *Transactions of the American Nuclear Society*.
6. Material initially published in a language other than English may be included both when an item is published in the original language and when an item appears in an English language translation.
7. All U. S. Atomic Energy Commission research and development reports in printed form which have been made publicly available at the National Technical Information Service (NTIS) are included in *NSA*. Also included in *NSA* are the printed reports from the national nuclear energy organizations of the United Kingdom, Japan, Canada, Sweden, Denmark, Norway, Australia, and France which have been made publicly available at NTIS.
8. Related groups of engineering drawings and specifications are abstracted and indexed in *NSA* when they become publicly available.
9. As a general practice, material more than two years old is not included in *NSA*.

All journals scanned regularly are listed in Issue No. 1 of each new volume. New additions are listed in issues numbered 7, 13, and 19 of each volume.

Part 1
SCOPE AND ARRANGEMENT

CHEMISTRY

Analytical Chemistry

[Analytical chemistry of isotopes, transactinides, actinides, lanthanides, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, or any element or compound if the application is directly associated with nuclear technology. Analyses to determine reactor fuel burnup are included, but burnup calculations are included under **REACTOR TECHNOLOGY**. Arrangement is according to analytical procedure. Information relative to analytical methods is included as indicated.]

Activation and Nuclear Reaction Procedures

The subject in general or descriptions of the method.

Chemical and Spectral Procedures

Radiometric and Radiochemical Procedures

Nuclear radiometric or radiochemical procedure, including properties of radioisotopes as sources in x-ray analyses. Routine tracer studies are excluded.

Separation Procedures

Separation procedures for isotopes, transactinides, actinides, lanthanides, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, and any material of interest in nuclear technology except the procedures covered elsewhere, e.g., under **Activation Procedures, Reactor Fuel Reprocessing,** and **Radioactive Waste Treatment.**

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Chemical and physicochemical properties of nonradioactive elements, compounds, or mixtures directly associated with nuclear technology.

Isotope Effects

Isotope effects on nonnuclear chemical and physical properties. Isotope effects are excluded when used only as a tool in the analysis of reaction mechanisms or in structure studies.

Isotope Exchange and Isotope Separation

Isotope exchange if the exchange is of primary concern or the exchange mechanism is used in isotope separation.

Chemical and physicochemical isotope separations are included here; but industrial scale processes such as gaseous diffusion and centrifugation are included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY**. Radioisotope production is included under **Radiochemistry and Nuclear Chemistry.**

Feed Materials Processing

Chemical processing of ores for recovery of uranium or thorium, including all extraction, conversion, or reduction steps. Also includes chemical engineering of plants for such processing, but site surveys and environmental impact are included under **ENVIRONMENTAL AND EARTH SCIENCES.**

Radiation Chemistry

[The radiations considered here include accelerated ions, gamma radiation, x radiation, bremsstrahlung, neutrons, protons, alpha particles, beta particles, deuterons, and other subatomic particles. Ultraviolet, infrared, and visible radiations are not included.]

Radiation effects on the chemical and physicochemical properties of any element, compound, or mixture. Radiation effects on biochemicals is included under **LIFE SCIENCES.** Radiation effects on metallurgical or solid state properties are included under **MATERIALS** or **PHYSICS (SOLID-STATE).**

Radiochemistry and Nuclear Chemistry

Radiochemistry and nuclear chemistry are included without restrictions except for tracer applications and labeled compound preparation, which are included only if there is a contribution to the technology.

Hot-Atom Chemistry

Any aspect, including recoil production and reactions.

Properties of Radioactive Materials

Chemical and physicochemical properties of radioactive elements or materials, including the stability of labeled compounds and chemical decontamination of surfaces or work areas. Decontamination of reactor vessels following accidents is included under **REACTOR TECHNOLOGY.**

Radioactive Waste Treatment

Radioactive waste processing for concentration, decontamination, or fission product recovery.

Waste disposal monitoring is included under **ENVIRONMENTAL AND EARTH SCIENCES;** waste disposal is included under **NUCLEAR MATERIALS MANAGEMENT.**

Radioisotope Production

Radioisotope production processes involving chemical separations. Development and uses of radioisotope radiation sources are included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Reactor Fuel Reprocessing

Reactor fuel reprocessing, including analytical control, chemical separations, solvent studies, and plant and process design, performance, and operation. Environmental monitoring

and impact are included under **ENVIRONMENTAL AND EARTH SCIENCES.**

ENGINEERING

Energy Conversion

Equipment and methods for the conversion of energy directly into electric energy, e.g., thermionic, thermoelectric, MHD, etc., and the production of electric energy through novel or previously undeveloped technology.

Facilities and Equipment

Nuclear facilities and equipment for which no more appropriate category has been provided. In general, information on facilities and equipment is included under categories more closely related to the purpose of the facility or equipment, e.g., **CHEMISTRY, PARTICLE ACCELERATORS, REACTOR TECHNOLOGY.**

Heat Transfer and Fluid Flow

Heat transfer and fluid flow if nucleate boiling, boiling burnout, two-phase flow, flow in rod bundles, or liquid metals are involved. Heat transfer or fluid flow applied in nuclear technology is included under sections on the basis of application.

Materials Testing

Destructive or nondestructive materials testing if a direct application to nuclear technology is indicated and if categorization on the basis of application would be less appropriate. In general, information on component testing is included under categories more closely related to the component, e.g., information on reactor fuel element testing is included under **REACTOR TECHNOLOGY.**

The use of radioisotopes and radiation sources in radiographic or radiometric testing is included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Nuclear Explosions

Detection of nuclear explosions and civil uses of nuclear explosions, including simulations using non-nuclear explosives.

Protective Structures and Equipment

Structures and equipment, such as fallout shelters, glove boxes, hot cells, masks, and special clothing for protection in radiation environments. The fabrication of bulk shielding is included under **MATERIALS**; remote-handling equipment is included under **NUCLEAR MATERIALS MANAGEMENT.**

Safety Engineering

Safety at nuclear facilities if no more appropriate category is provided. In general, safety engineering information is included under categories for specific activities or facilities, e.g., **NUCLEAR EXPLOSIONS** or **REACTOR TECHNOLOGY.**

Vacuum Engineering

Ultrahigh (10^{-9} torr or greater) vacuum systems and equipment if no nuclear application is indicated. Applied vacuum engineering is included under categories for the applications, e.g., **PARTICLE ACCELERATORS.**

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Identification, properties, prospecting, mining, and estimated reserves of thorium and uranium minerals and ores (including equipment). Chemical processing of ores is included under **CHEMISTRY.**

Radioactive Effluents

Concentration or levels of radioactive materials discharged to the natural environment (atmosphere, soil, and waters) under accident or normal operating conditions at nuclear facilities.

Radioactivity Monitoring and Transport

Monitoring and/or transport and distribution of radioactive materials (including natural radioactivity) in or through the atmosphere, soil, or waters of the earth. Also includes monitoring and radiation hazards presented by radioactive materials in ecosystems or food cycles. Instrumentation for monitoring radioactivity is included under **INSTRUMENTATION.**

Radiometric Techniques

Use of radioisotopes or radiation sources in investigations of the environment or the earth, e.g., soil and water movement, isotopic methods of geochronology, etc., if the technique is of primary concern or is presented as an advancement of the technology. Instrument design is included under **INSTRUMENTATION.**

Site Surveys

Evaluation and selection of sites for nuclear installations such as fuel fabrication plants, radiochemical processing plants, and nuclear explosions. Seismological and background radiation surveys are included. Nuclear power plant siting is included under **REACTOR TECHNOLOGY.**

Thermal Effluents

Characteristics, quantities, and effects of thermal discharges to the atmosphere, soil, or waters of the earth from chemical plants, both fossil- and nuclear-fueled power plants, or any other facility with thermal discharges of the same order of magnitude.

INSTRUMENTATION

Radiation Detection Instruments

Arrangement is as follows:

General Detectors and Monitors

Radiation Dosimeters

Nuclear Spectroscopic Instrumentation (Includes Moessbauer Spectrometers)

High-Energy Physics Instrumentation

Radiometric Instruments

Any instrument employing a radiation source and/or radiation detector in its operation.

Radiation Effects on Any Instrument Component, Instrument, or Electronic System

Miscellaneous Instruments, Instrument Component, or Instrumentation Systems

Limited to applications in nuclear technology.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Industrial processes for heavy water production, uranium enrichment, or other isotope separation.

Isotopic Power Sources

Use of radioisotopes (fission products) as sources of electric, propulsive, or thermal energy.

Radiation Sources

Design or fabrication of radiation sources, including neutron sources, but not accelerators or reactors. Use of radiation sources in industrial processes such as food processing, sterilization of medical supplies, polymer production, etc. Basic radiation effects is included under **CHEMISTRY** or **LIFE SCIENCES**, but information on radiation effects that influence product acceptability or marketability, such as color or taste, is included here.

LIFE SCIENCES

. [For this section the term **RADIATION** is defined as nuclear particles, accelerated electrons and ions, and γ and x radiations. Information on uv effects is included *only* if microorganisms, cells, or biochemicals are the subjects of study. Laser radiation, magnetic fields, microwaves, and sunlight are excluded. The concept of **RADIATION EFFECTS** includes the effect itself, radiomimetic effects, and any information relating to the effect, e.g., information on assessment, prevention, alteration, transmission, reversal, recovery, etc., and information on the determination or influence of experimental variables such as dose, dose rate, LET, etc.]

Radiation Effects (External Sources)

(Includes effects of radiations from implanted sources, but not those from incorporated radioactive materials.)

Effects on Biochemicals

Effects on either in-vitro and in-vivo biochemicals. Also includes the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under **CHEMISTRY** or **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Effects on Cultured Cells

Effects of radiation from external sources on cells in cultures; effects on in-vivo cells is included in other **LIFE SCIENCES** categories for entire organisms. Also includes information on the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under **CHEMISTRY** or **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Effects on Microorganisms

Effects on microorganisms, including bacteria, fungi, plankton, and yeasts. Uses of radiation in industrial processes for the radiopreservation of food, radiosterilization of medical supplies, radiation preparation of vaccines, etc., are included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY** unless effects on specific organisms are considered.

Effects on Plants

Effects on plants (including all algae and in-vivo studies on plant cells), including the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources included under **CHEMISTRY** or **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.** Industrial processes for radiopreservation or disinfestation of foods is under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Effects on Animals

Man

Effects on man or on human tissues or cells in-vivo. Therapeutic irradiation is included *only* if there is significant information on the effects on normal tissues.

Vertebrates

Effects on vertebrates or on vertebrate tissues or cells in vivo, including the preparation of animals for irradiation and irradiation procedures. The preparation of radiation sources is included under **CHEMISTRY** or **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.**

Invertebrates

Effects on invertebrates or on invertebrate tissues or cells in vivo, including the preparation of the animal for irradiation and irradiation procedures. The preparation of radiation sources is included under **CHEMISTRY** or **ISOTOPE AND RADIATION SOURCE TECHNOLOGY.** Industrial scale processes for pest control and crop disinfestation are included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY** unless there is significant information on the effects of radiation on specific organisms.

Radionuclide Effects (Internal Source)

[Absorbed or incorporated radioactive materials, not implanted sources, in any biological entity.] Internal source evaluation and effects, including experimental procedures, but not the preparation of labeled compounds for administration.

Nuclide Kinetics and Toxicology

Kinetics and toxicology of deuterium and radionuclides in or on living organisms. Also includes contamination and decon-

tamination, both internal and external, of living organisms. Levels and movement of radionuclides through man's environment are included under **ENVIRONMENTAL AND EARTH SCIENCES.**

New Tracer Techniques

Use of isotope tracers in **LIFE SCIENCES** research if a contribution is made to the technology of tracer usage. Also includes extensive bibliographies or reviews.

MATERIALS

Corrosion, erosion, preparation, fabrication, properties (excluding solid-state), and phase studies are included with the limitations indicated in the arrangement scheme below.

Ceramics and Cermets

Limited to the borides, carbides, hydrides, nitrides, and oxides of those elements in Part 2 in which a metallurgy interest is indicated.

Metals and Alloys

Limited to those elements in Part 2 in which a metallurgy interest is indicated.

Other Materials

Limited to materials applied or specifically for application in nuclear technology, e.g., carbon, graphite, concretes, plastics.

Radiation damage in or radiation effects on any material with the following exceptions:

Radiation effects on biological materials is included under **LIFE SCIENCES.**

Radiation effects on chemical or physicochemical properties is included under **CHEMISTRY.**

Radiation effects on crystallographic, electric, electronic, or magnetic properties is included under **PHYSICS (SOLID STATE).**

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Fissionable materials, radioactive materials, or materials of special interest such as heavy water. The arrangement is as follows:

Accountability and Safeguards
Disposal and Storage
Handling Equipment and Procedures
Transportation

Radioactive waste processing is included under **CHEMISTRY**

PARTICLE ACCELERATORS

Particle, ion, atom, or molecule accelerators. The arrangement is as follows:

Design, Development, and Operation
Auxiliaries and Components
Ion Sources and Injection and Extraction Systems
Ion Optics and Field Calculations
Storage Rings
Experimental Facilities (Includes Radiation Targets)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Cosmic radiation, including exposure ages of meteorites. Cosmic-ray interactions with the atmosphere and with the geomagnetic field are included under **PHYSICS (ATMOSPHERIC).**

Stars

Composition, evolution, physical conditions, and nucleogenesis of stars; celestial mechanics is excluded.

Quasi-Stellar, Radio, and X-Ray Sources

Theory and detailed studies; the location of such objects is excluded.

Solar Phenomena

Sunspots and solar prominences, disturbances, wind, flares, radio bursts, magnetic fields; origin and evolution of the solar system; and structure and spectra of the sun. Solar wind interactions with the atmosphere or geomagnetic field are included under **PHYSICS (ATMOSPHERIC).**

Galaxies

Only if related to radiation, nuclear phenomena, or plasma physics; celestial mechanics is excluded.

Cosmology

Structure and evolution of the Universe.

Planetary Phenomena

Interplanetary magnetic fields, radio emissions, and radiation belts only. Van Allen belts are included under **PHYSICS (ATMOSPHERIC).**

PHYSICS (ATMOSPHERIC)

Particle kinetics associated with aurorae or ionospheric phenomena, effects of nuclear explosions in the atmosphere, particle kinetics and trapping in the atmosphere (Van Allen belts), and cosmic-ray or solar-wind interactions with the atmosphere or with the geomagnetic field.

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Methods of production and techniques of using atomic, electron, ion, and molecular beams.

Electron and ion sources not developed for specific applications.

Reactions of beams with materials in bulk (e.g., scattering by surfaces, secondary emission, sputtering yields, etc.)

Atomic and Molecular Properties

Atomic properties (experimental and theoretical studies) of helium, hydrogen (also deuterium and tritium), the lanthanides, technetium, and elements having $Z \geq 84$.

Molecular properties of deuterium, helium (He_2, He_3, etc.), helium hydrides, hydrogen (H_2, H_2^+, H_3^+, etc.), tritium, and compounds of technetium and of elements having $Z \geq 84$.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Properties of positronium, muonium, and muonic and mesic (π, K, etc.) atoms and molecules. *Note*: for exotic atoms (involving antiprotons, hyperons, etc.) see **PHYSICS (HIGH-ENERGY)**.

Basic mechanisms of positron annihilation, but not studies using positron annihilation as a tool.

Collision Phenomena

Experimental and theoretical studies of elastic scattering, charge exchange (electron capture, electron loss, and electron attachment or detachment), excitation (deexcitation, excitation transfer), ionization, or dissociation in collisions of the following type: electron–ion, electron–atom, electron–molecule, ion–ion, ion–atom, ion–molecule, atom–atom, and atom–molecule.

Rearrangement collisions ($A + BC \rightarrow AB + C$), chemical exchange, and collisions in confined gases when no external beam is involved are excluded.

Atomic Theory

Theory of atomic structure and properties when generally applicable. For theoretical studies of specific elements, see first statement under **Atomic and Molecular Properties.**

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Electrofluid and magnetofluid mechanics only.

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Experimental studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under **PHYSICS (NUCLEAR).**

Particle Interactions and Properties (Theoretical)

Theoretical studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under **PHYSICS (NUCLEAR).**

Particle Invariance Principles and Symmetries

Space-time symmetries and internal symmetries of particles and the applications of these symmetries to the electromagnetic, weak, and strong interactions.

Field Theories

Quantum field theories, quantum electrodynamics, relativistic mechanics, and gravitation and general relativity theory.

Scattering Theory

General scattering theory only; the application of scattering theory to specific interactions or types of particles is included under sections according to type of interaction.

PHYSICS (LOW-TEMPERATURE)

Superfluidity, superconductivity, and equipment and devices when emphasis is on the superconductor or superfluid helium. Applications of superconducting devices are included under sections according to application; e.g., **PARTICLE ACCELERATORS.**

PHYSICS (NUCLEAR)

The arrangement is as follows:

Neutron Interactions with Matter

Neutron absorption, scattering, thermalization, transport, etc., in macroscopic systems, including solution of the neutron transport equation and theoretical neutron transport in matter in general geometric configurations.

Nuclear Properties and Reactions $A < 5$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $6 < A < 19$

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 20 < A < 38

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 39 < A < 58

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 59 < A < 89

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 90 < A < 149

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 150 < A < 189

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions 190 < A < 219

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions A > 220

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Theory

Nuclear structure, nuclear matter, nuclear reactions and scattering, nuclear moments and spin, radioactive decay, spontaneous and induced fission, and nuclear models.

PHYSICS (PLASMA AND THERMONUCLEAR)

Plasma and thermonuclear physics, except solid-state plasma, arranged as follows:

Confinement and Heating
Diagnostics
Kinetics (General)
Kinetics (Experimental)
Kinetics (Theoretical)
Production
Stability
Thermonuclear Processes
Wave Phenomena

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Basic physical characteristics of radiation or of radiation passage through or scattering from materials not generally defined as shielding. Neutron transport in macroscopic systems is included under **PHYSICS (NUCLEAR).**

Radiation Protection Standards

Standards written for a specific circumstance are included under appropriate sections.

Radiation Source Calibration and Standardization

Radiation source design and fabrication and radiation source preparation are included under **ISOTOPE AND RADIATION SOURCE TECHNOLOGY** or **CHEMISTRY.**

Shielding Calculations and Theory

Neutron shielding and shield fabrication are included under **PHYSICS (NUCLEAR)** and **MATERIALS.** Shield design is included under sections for the application, e.g., **PARTICLE ACCELERATORS** or **REACTOR TECHNOLOGY.**

PHYSICS (SOLID-STATE)

Crystallographic, electric, electronic, and magnetic properties of specific materials of interest. Materials of interest consist of the elements in Part 2 with a solid-state interest indicated, and the borides, carbides, hydrides, nitrides, and oxides of those elements. Complex structures such as spinels and ferrates are excluded.

The arrangement is as follows:

Radiation Effects
Solid-State Properties of All Solids
Physical Properties
Moessbauer Effect and NMR
Theory

Basic information and instrumentation for Moessbauer Effect and NMR is included under **PHYSICS (NUCLEAR)** and **INSTRUMENTATION.**

REACTOR TECHNOLOGY

Design, development, construction, economics, siting studies, direct effects (both radiological and thermal), and forecasts of nuclear fission reactors and ancillary power plants. Included also is all information on nuclear systems, control systems, instrumentation for specific reactors, engineered safeguard

systems, containment systems, pressure vessels, shielding, and monitoring and health physics studies of reactor sites. Heat transfer and fluid flow studies and component design and development are also included. Fabrication, preparation, corrosion, erosion, structure, phase studies, and radiation effects studies are included under **MATERIALS.**

Arrangement is as follows:

Power Reactor Development

New power reactor concepts, theoretical power reactor studies, and prototype reactor power plants.

Commercial Power Reactors

Standardized (nondevelopmental) reactor power plants constructed for commercial generation of electric power.

Propulsion and Auxiliary Power Reactors

Aircraft, marine, rocket, surface-effects machine, or land vehicular propulsion power plants, or relatively small electric power-generating reactors for special applications.

Process Heat and Desalination Reactors

Reactor plants for water distillation or desalination, chemical processes, metallurgical processes, or space heating. Dual-purpose plants are included.

Research and Test Reactors

High- and low-flux reactors intended for irradiation of samples, fuel burnup studies, isotope production, and core physics studies. Also includes critical assemblies and exponential piles.

Production Reactors

Nonpower producing converter or breeder reactors, operating for the primary purpose of producing fissile materials.

Reactor Components, Fuels, and Accessories for unspecified reactors

Reactor Physics and Core Engineering for unspecified reactors

GENERAL

Civilian Defense

Administrative and planning aspects only.

Law

Legislative action and activities of agencies, committees, or organizations.

Miscellaneous

Publicly available annual administrative and research and development reports from the United States Atomic Energy Commission and the national nuclear energy organizations of the United Kingdom, Canada, Sweden, Denmark, Japan, Australia, France, and Norway which are outside the subject scope of other categories.

Part 2

EXTENT OF INTEREST IN THE ELEMENTS

ACTINIUM
All scientific and technical aspects

ALUMINUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

AMERICIUM
All scientific and technical aspects

ANTIMONY
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARGON
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ARSENIC
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

ASTATINE
All scientific and technical aspects

BARIUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BERKELIUM
All scientific and technical aspects

BERYLLIUM
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state physics

BISMUTH
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid bismuth
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

BORON
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steel containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

BROMINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CADMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steel containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

CALCIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CALIFORNIUM

All scientific and technical aspects

CARBON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, it compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Properties and fabrication of nuclear-grade graphite and graphite fuel materials

Radiation effects

Radiochemistry

CERIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

CESIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHLORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine application as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CHROMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

COBALT

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

COPPER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

CURIUM

All scientific and technical aspects

DYSPROSIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application) compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

EINSTEINIUM

All scientific and technical aspects

ERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

EUROPIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

FERMIUM

All scientific and technical aspects

FLUORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

FRANCIUM

All scientific and technical aspects

GADOLINIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

GALLIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

GERMANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

GOLD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

HAFNIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

HELIUM

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Superfluidity

HOLMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

HYDROGEN

Applications of the element or its compounds and systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of deuterium and tritium

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

INDIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

IODINE

Analysis, determination, and separation

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

IRIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

IRON

Applications of the element and its alloys or systems, including steel and stainless steel, in nuclear technology or the behavior of the element, its alloys, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

KRYPTON

Analysis, determination, and separation

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LANTHANUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

LAWRENCIUM (103)

All scientific and technical information

LEAD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LITHIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

LUTETIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

MAGNESIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MANGANESE

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MENDELEVIUM

All scientific and technical aspects

MERCURY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

MOLYBDENUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys, compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NEON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NEPTUNIUM

All scientific and technical aspects

NICKEL

Applications of the element or its alloys, compounds, or systems, in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NIOBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

NITROGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

NOBELIUM

All scientific and technical aspects

OSMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

OXYGEN

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PALLADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PHOSPHORUS

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLATINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PLUTONIUM

All scientific and technical aspects

POLONIUM

All scientific and technical aspects

POTASSIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

PRASEODYMIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

PROMETHIUM

All scientific and technical aspects

PROTACTINIUM

All scientific and technical aspects

RADIUM

All scientific and technical aspects

RADON

All scientific and technical aspects

RHENIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

RHODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

RUBIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

RUTHENIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SAMARIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state physics

SCANDIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

SELENIUM

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILICON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SILVER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SODIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of liquid sodium in cooling systems
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

STRONTIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

SULFUR

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

TANTALUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

TECHNETIUM

All scientific and technical aspects

TELLURIUM

Analysis, determination, and separation

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Radiation effects

Radiochemistry

Solid-state physics

THALLIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

THORIUM

All scientific and technical aspects except mining and routine industrial uses, e.g., thoriated cathodes

THULIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

TIN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TITANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

TRANSLAWRENCIUM ELEMENTS

All scientific and technical aspects

TUNGSTEN

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

URANIUM

All scientific and technical aspects except mining and routine industrial applications

VANADIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element,

its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

XENON

Analysis, determination, and separation

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

YTTERBIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

YTTRIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

ZINC

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

ZIRCONIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state physics

Appendix II
JOURNAL LIST

This list of journals supplements the listing which appeared as Appendix II in Volume 26, Number 1. The journals are arranged alphabetically by abbreviation. Additional supplements will be included in numbers 13 and 19 of this volume.

The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579 (6th Ed.) *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia, 22151, for $6.00 for full size or reproduction copy and $0.95 for microfiche copy.

A

Acta Univ. Agr. (Brno), Ser. C
Acta Univ. Agr. (Brno), Series C (Facultas Silviculturae) (Czechoslovakia)

Acta Univ. Upsal., Abstr. Uppsala Diss. Fac. Sci.
Acta Universitatis Upsaliensis, Abstracts of Uppsala Dissertations from the Faculty of Science (Sweden)
Supersedes Acta Univ. Upsal., Abstr. Uppsala Diss. Sci.

Aerotec.-Missili Spazio
Aerotecnica-Missili e Spazio (Italy)
Formed by merger of Aerotecnica and Missili e Spazio

Alimenta (Zurich)
Alimenta (Zurich) (Switzerland)

Amer. Fam. Physician
American Family Physician (U.S.)
Supersedes American Family Physician - GP

An. Univ. Bucuresti, Chim.
Analele Universitatii Bucuresti, Chimie (Romania)

Ann. Acad. Sci. Fenn., Ser. A III
Annales Academiae Scientiarum Fennicae, Series A III. Geologica-Geographica (Finland)

Ann. Acad. Sci. Fenn., Ser. A V
Annales Academiae Scientiarum Fennicae, Series A V. Medical (Finland)

Annu. Rev. Mater. Sci.
Annual Review of Materials Science (U.S.)

Appl. Elec. Phenomena (Engl. Transl.)
Applied Electrical Phenomena (English Translation of Elektronnaya Obrabotka Materialov) (U.S.)

Arch. Dermatol. Forsch.
Archiv fuer Dermatologische Forschung (West Germany)
Supersedes Arch. Klin. Exp. Dermatol.

Arch. Sci. Biol. (Bologna)
Archivio di Scienze Biologiche (Bologna) (Italy)

Ark. Mat., Astron. Fys.
Arkiv for Matematik, Astronomi och Fysik (Sweden)

Astronautyka
Astronautyka (Poland)

At. Jap.
Atoms in Japan (Japan)

Aufbereitungs-Tech.
Aufbereitungs-Technik (West Germany)

Aufschluss
Aufschluss (West Germany)

Awamia
Awamia, Al (Morocco)

B

Ber. Getreidechem.-Tag., Detmold
Bericht ueber die Getreidechemiker-Tagung, Detmold (West Germany)

Beton, Herstellung, Verwend.
Beton, Herstellung, Verwendung (West Germany)

Biol. Neonate
Biology of the Neonate (Switzerland)
Supersedes Biol. Neonatorum

Boll. Mal. Orecchio, Gola Naso
Bollettino delle Malattie dell'Orecchio, della Gola e del Naso (Italy)

Boll. Soc. Geol. Ital.
Bollettino della Societa Geologica Italiana (Italy)

Boll. Unione Mat. Ital.
Bollettino dell'Unione Matematica Italiana (Italy)

Bot. Rev.
Botanical Review, THe (U.S.)

Brit. Chem. Eng. Process Technol.
British Chemical Engineering and Process Technology (England)
Supersedes British Chemical Engineering

Bull. Bot. Soc. Bengal
Bulletin of the Botanical Society of Bengal (India)

Bull. Doc., Cent. Inform. Chrome Dur
Bulletin de Documentation, Centre d'Information du Chrome Dur (France)

Bull. Grain Technol.
Bulletin of Grain Technology (India)

Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR
Byulleten Instituta Astrofiziki, Akademiya Nauk Tadzhikskoi SSR (Tadzhik S.S.R.)

Byull. Nauch.-Tekh. Inform. Agron. Fiz.
Byulleten Nauchno-Tekhnicheskoi Informatsii po Agronomicheskoi Fizike (U.S.S.R.)

Byull. Tsentra Yadern. Dannym
Byulleten Tsentra po Yadernym Dannym (U.S.S.R.)

C

Can. Geogr.
Canadian Geographer (Canada)

Can. J. Pharm. Sci.
Canadian Journal of Pharmaceutical Sciences (Canada)

Cardiology
Cardiology (Switzerland)
Supersedes Cardiologia

Cell. Immunol.
Cellular Immunology (U.S.)

Chagyo Gijutsu Kenkyu
Chagyo Gijutsu Kenkyu (Study of Tea) (Japan)

Chem. Stosow., Ser. B
Chemia Stosowana, Seria B. Kwartalnik Poswiecony Zagadnieniom Inzynierii i Aparatury Chemicznej (Poland)

Chem.-Ztg., Chem. App.
Chemiker-Zeitung, Chemische Apparatur (West Germany)
Supersedes Chemiker-Zeitung

Chislennye Metody Mekh. Sploshnoi Sredy
Chislennye Metody Mekhaniki Sploshnoi Sredy (U.S.S.R.)

Clin. Otorinolaringoiat.
Clinica Otorinolaringoiatrica (Italy)

Commentat. Biol.
Commentationes Biologicae, Societas Scientiarum Fennica (Finland)

Computing
Computing (Austria)

Confructa
Confructa (West Germany)

Contam. Contr.
Contamination Control (U.S.)

Cutting Tool Eng.
Cutting Tool Engineering (U.S.)

D

Denki Keisan
Denki Keisan (Electrical Calculaton) (Japan)

Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku
Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku (Japan)

Doboku Gijutsu Shiryo
Doboku Gijutsu Shiryo (Public Works Review) (Japan)

Draht
Draht (West Germany)

Draht-Welt
Draht-Welt (West Germany)

Drug Ther. Bull.
Drug and Therapeutics Bulletin (England)

E

Earth Sci. Bull.
Earth Science Bulletin (U.S.)

Ecology (USSR) (Engl. Transl.)
Ecology (USSR) (English Translation of Ekologiya) (U.S.)

Econ. Int. Fonti Energ.
Economia Internazionale delle Fonti di Energia (Italy)

Elelmiszervizsgalati Kozlem.
Elelmiszervizsgalati Kozlemenyek (Hungary)

Energ. Elek.
Energetika i Elektrifikatsiya (Ukrainian S.S.R.)

Energ. Stroit.
Energeticheskoe Stroitel'stvo (U.S.S.R.)

Energiewirt. Tagesfragen
Energiewirtschaftliche Tagesfragen (West Germany)

Environ. Aff.
Environmental Affairs (U.S.)

Environ. Contr. Saf. Manage.
Environmental Control and Safety Management (U.S.)

Enzyme
Enzyme (Switzerland)
Supersedes Enzymol. Biol. Clin.

EOS, Trans., Amer. Geophys. Union
EOS, Transactions, American Geophysical Union (U.S.)
Supersedes Trans. Amer. Geophys. Union

F

Farm J. (Calcutta)
Farm Journal (Calcutta) (India)

Farmacia (Bucharest)
Farmacia (Bucharest) (Romania)

Fertigung
Fertigung (Switzerland)

Festkoerperprobleme
Festkoerperprobleme (West Germany)

Fiz. Szk.
Fizyka w Szkole (Poland)

Folia Forest. (Helsinki)
Folia Forestalia (Helsinki) (Finland)

G

Galvano
Galvano (France)

Gartenbauwissenschaft
Gartenbauwissenschaft (West Germany)

Geokhim. Sb.
Geokhimicheskii Sbornik (U.S.S.R.)

Glastech. Ber.
Glastechnische Berichte (West Germany)

God. Sofii. Univ., Biol. Fak.
Godishnik na Sofiiskiya Universitet, Biologicheski Fakultet (Bulgaria)

God. Sofii. Univ., Fiz. Fak.
Godishnik na Sofiiskiya Universitet, Fizicheski Fakultet (Bulgaria)

God. Zb. Med. Fak. Skopje
Godisen Zbornik na Medicinskiot Fakultet vo Skopje (Yugoslavia)

H

Haematol. Bluttransfus.
Haematologie und Bluttransfusion (Suppl. to Blut) (West Germany)

Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo
Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo (Proceedings of the Research Institute for Nuclear Medicine and Biology, Hiroshima University) (Japan)

Hiroshima Nogyo Tanki Daigaku Kenkyu Hokoku
Hiroshima Nogyo Tanki Daigaku Kenkyu Hokoku (Bulletin of the Hiroshima Agricultural College) (Japan)

Hokkaido Daigaku Kogakubu Kenkyu Hokoku
Hokkaido Daigaku Kogakubu Kenkyu Hokoku (Bulletin of the Faculty of Engineering, Hokkaido University) (Japan)

HortScience
HortScience (U.S.)

Hoshasen Butsuri Kenkyu
Hoshasen Butsuri Kenkyu (Japan)

Hum. Pathol.
Human Pathology (U.S.)

I

IEE (Inst. Elec. Eng.) Rev.
IEE (Institution of Electrical Engineers) Reviews (A Special Issue of the Proc. Inst. Elec. Eng.) (England)

Indiana Univ. Math. J.
Indiana University Mathematics Journal (U.S.)
Supersedes J. Math. Mech.

Indian Eng.
Indian Engineer (India)

Indian J. Anim. Sci.
Indian Journal of Animal Sciences (India)

Ingegneria
Ingegneria (Italy)

Int. Comp. Law Quart.
International and Comparative Law Quarterly, The (England)

Int. J. Environ. Anal. Chem.
International Journal of Environmental Analytical Chemistry (England)

Int. J. Mech. Sci.
International Journal of Mechanical Sciences (England)

Int. Ver. Theor. Angew. Limnol., Mitt.
International Vereinigung fuer Theoretische und Angewandte Limnologie, Mitteilungen (West Germany)

Iwate Igaku Zasshi
Iwate Igaku Zasshi (Journal of the Iwate Medical Association) (Japan)

Izotoptechnika
Izotoptechnika (Hungary)
Supersedes Atomtech. Tajek.

Izv. Akad. Nauk Tadzh. SSR, Otd. Fiz.-Mat. Geol.-Khim. Nauk
Izvestiya Akademii Nauk Tadzhikskoi SSR, Otdelenie Fiziko-Matematicheskikh i Geologo-Khimicheskikh Nauk (Tadzhik S.S.R.)

Izv. Estestvennonauch. Inst. Perm. Gos. Univ.
Izvestiya Estestvennonauchnogo Instituta pri Permskom Gosudarstvennom Universitete (U.S.S.R.)

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Biol. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Biologicheskikh Nauk (U.S.S.R.)
Supersedes Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Biol.-Med. Nauk

Izv. Vyssh. Ucheb. Zaved., Neft Gaz
Izvestiya Vysshikh Uchebnykh Zavedenii, Neft i Gaz (Azerbaidzhan S.S.R.)

J

J. Allergy Clin. Immunol.
Journal of Allergy and Clinical Immunology (U.S.)
Supersedes J. Allergy

J. Conn. State Dent. Ass.
Journal of the Connecticut State Dental Association (U.S.)

J. Coord. Chem.
Journal of Coordination Chemistry (England)

J. Fla. Med. Ass.
Journal of the Florida Medical Association (U.S.)

J. Ga. Entomol. Soc.
Journal of the Georgia Entomological Society (U.S.)

J. Geol. Soc. India
Journal of the Geological Society of India (India)

J. Jap. Soc. Appl. Phys., Suppl.
Journal of the Japan Society of Applied Physics, Supplement (Japan)

J. Microscopy
Journal of Microscopy (England)
Supersedes J. Roy. Microscop. Soc.

J. Paint Technol.
Journal of Paint Technology (U.S.)

Jinruigaku Zasshi
Jinruigaku Zasshi (The Journal of the Anthropological Society of Japan) (Japan)

Joekull (Reykjavik)
Joekull (Reykjavik) (Iceland)

K

Kagaku Keizai
Kagaku Keizai (Chemical Industrial Economy) (Japan)

KFK Nachr.
KFK (Kernforschungszentrum Karlsruhe) Nachrichten (West Germany)

Kibern. Vychisl. Tekh.
Kibernetika i Vychislitel'naya Tekhnika (Ukrainian S.S.R.)

Kim. Sanayi
Kimya ve Sanayi (Turkey)

Koku Igaku Jikkentai Hokoku
Koku Igaku Jikkentai Hokoku (The Reports of the Aero Medical Lab.) (Japan)

Korean J. Hort. Sci.
Korean Journal of Horticultural Science (Hankuk Wonyehakhow-ji) (South Korea)

Kotsu Igaku
Kotsu Igaku (The Journal of Transportation Medicine) (Japan)

Kuki Chowa To Reito
Kuki Chowa To Reito (Air Conditioning and Refrigeration) (Japan)

Kvantovaya Elektron.
Kvantovaya Elektronika (Ukrainian S.S.R.)

L

Log Anal.
Log Analyst (U.S.)

M

Magy. Asvanyolaj Foldgaz Kiss... Intez. Kiadv.
Magyar Asvanyolaj es Foldgaz Kiserleti Intezet Kiadvanyai (Hungary)

Magy. Textiltech.
Magyar Textiltechnika (Hungary)

Maintenance
Maintenance (France)

Med. Lab. Technol.
Medical Laboratory Technology (England)
Supersedes J. Med. Lab. Technol.

Mem. Real Acad. Cienc. Artes Barcelona
Memorias de la Real Academia de Ciencias y Artes de Barcelona (Spain)

Metallges., Rev. Activ.
Metallgesellschaft, Review of the Activities (West Germany)
German Edition issued as Metallges., Mitt. Arbeitsbereich

Metallofizika
Metallofizika (Ukrainian S.S.R.)

Metallurgie (Mons, Belg.)
Metallurgie (Mons, Belgium) (Belgium)

Metalwork. Econ.
Metalworking Economics (U.S.)

Methods Biochem. Anal.
Methods of Biochemical Analysis (U.S.)

Miner. Sci. Eng.
Minerals Science and Engineering (South Africa)

Minneapolis Dist. Dent. J.
Minneapolis District Dental Journal, The (U.S.)

Mitsubishi Seiko Giho
Mitsubishi Seiko Giho (Japan)

Modif. Polim. Mater.
Modifikatsiya Polimernykh Materialov (Latvian S.S.R.)

Morsk. Gidrofiz. Issled.
Morskie Gidrofizicheskie Issledovaniya (U.S.S.R.)

Munca Sanit.
Munca Sanitara (Romania)

N

Nagoya-Shi Kogyo Kenkyusho Kenkyu Hokoku
Nagoya-Shi Kogyo Kenkyusho Kenkyu Hokoku (Research Reports for the Nagoya Municipal Industrial Research Institute) (Japan)

Natura (Plovdiv)
Natura (Plovdiv) (Bulgaria)

N. Z. J. Agr. Res.
New Zealand Journal of Agricultural Research (New Zealand)

Nor. Vet.-Tidsskr.
Norsk Veterinaer-Tidsskrift (Norway)

Nord. Hydrol.
Nordic Hydrology (Denmark)

O

Occup. Health Bull.
Occupational Health Bulletin (Canada)

P

Polym. J.
Polymer Journal (Japan)

Pr. Stud. Zakl. Badan Nauk. Gorn. Okregu Przem. Pol. Akad. Nauk
Prace i Studia Zakladu Badan Naukowych Gornoslaskiego Okregu Przemyslowego Polskiej Akademii Nauk (Poland)

Purasuchikkusu
Purasuchikkusu (Japan Plastics) (Japan)

R

Rend. Soc. Ital. Mineral. Petrologia
Rendiconti della Societa Italiana de Mineralogia e Petrologia (Italy)

Res. Commun. Chem. Pathol. Pharmacol.
Research Communications in Chemical Pathology and Pharmacology (U.S.)

Rev. Anal. Chem.
Reviews in Analytical Chemistry. International Quarterly Scientific Reviews Journal (Israel)

Rev. Coroz.
Revista de Coroziune (Romania)

Rev. Gaucha Odontol.
Revista Gaucha de Odontologia (Brazil)

Rev. High-Temp. Mater.
Reviews on High-Temperature Materials (Israel)

Rinsho Hinyokika
Rinsho Hinyokika (Japan)

Rinsho Kagaku
Rinsho Kagaku (Japan)

Russ. Eng. J.
Russian Engineering Journal (English Translation of Vestnik Mashinostroeniya) (England)

S

Sanit. Heizungstech.
Sanitaer - Heizungstechnik (West Germany)

Sanka To Fujinka
Sanka To Fujinka (Obstetrics and Gynecology, The) (Japan)

Sb. Nauch. Tr., Fiz.-Tekh. Inst. Nizk. Temp., Akad. Nauk Ukr. SSR
Sbornik Nauchnykh Trudov, Fiziko-Tekhnicheskii Institut Nizhikh Temperatur, Akademiya Nauk Ukrainskoi SSR (Ukrainian S.S.R.)

Sb. Tr. Kiyuchevsk. Zavoda Ferrosplavov
Sbornik Trudov Kiyuchevskogo Zavoda Ferrosplavov (U.S.S.R.)

Schiff Hafen
Schiff und Hafen (West Germany)

Schweisstechnik (Berlin)
Schweisstechnik (Berlin) (East Germany)

Schweiz. Z. Hydrol.
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